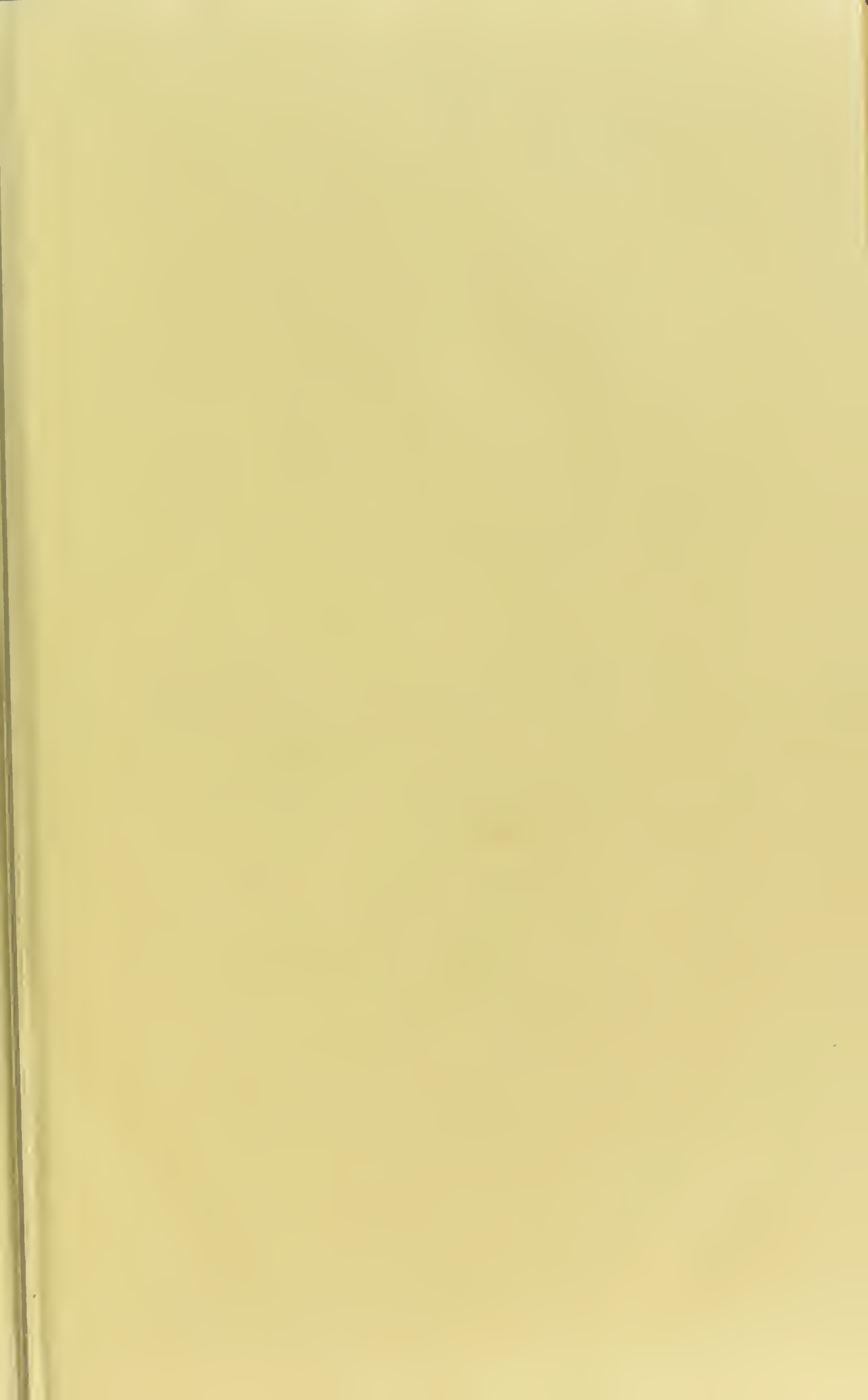


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EPITOME OF SURGERY.



by

Ernest Hart Esq

EPITOME OF SURGERY

BEING

A COMPLETE COMPENDIUM OF THE SCIENCE AND
ART OF SURGERY



BY

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THIS WORK IS DEDICATED,

IN ADMIRATION OF

THE MANY ADVANCES IN THE DOMAIN OF SURGERY

DUE TO HIS ORIGINAL WORK,

AND IN GRATEFUL REMEMBRANCE OF HIS SKILFUL TEACHING,

FRIENDLY ENCOURAGEMENT, AND MANY PERSONAL ACTS OF KINDNESS,

BY

THE AUTHOR.

P R E F A C E.

IN the preparation of this work it has been my intention to produce a synopsis of the most important points in Surgery, to serve the student as an aid to his memory when preparing for examination. From twelve years' experience in reading with candidates for a surgical diploma, I find that owing to the huge size attained by most of the standard text-books, the knowledge obtained from their perusal is not well arranged in the student's mind, nor readily at command during the trying ordeal of an examination. It is necessary, therefore, for the reader, after perusing one of the excellent treatises on the subject, to make use of a Remembrancer just prior to the date of examination, and it is for this purpose this book is intended. While written primarily for the student, the work will perhaps also be of some service to the practising surgeon, who may wish to refresh his memory on certain points, and for which purpose the book may afford a ready means of reference. I have consulted the various standard works, monographs on special subjects, which from their size or price are not easily accessible to the student, and the periodical medical literature of various countries. The chief labour has been in selection, and I have chosen those methods of treatment which, from many years' experience, I have found most advantageous. In the case of operations I have, as far as possible, followed literally the description of the surgeon who first performed or proposed each operation. From limited space, all notice of Diseases of the Ear, Dental Surgery, and Diseases of Women, with their operative treatment, has been omitted. I am much indebted to Drs. Abrath and Bowmaker for many valuable suggestions. My grateful thanks are also due, especially, to Dr. Bowmaker, for help in correcting the proof-sheets and in preparing the Index. I have endeavoured to make this little manual as complete and practical as possible, and trust it may be of service to those for whose assistance it is intended.

RIDLEY DALE.

SUNDERLAND,
November 1888.

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EPITOME OF SURGERY.

SECTION I.

INFLAMMATION AND ITS SEQUENCES.

CHAPTER I.

ACTIVE HYPERÆMIA—PASSIVE CONGESTION—INFLAMMATION.

Active determination of blood to a part, or Hypercemia, consists of an increased and accelerated blood flow through the vessels of the region affected.

Causes always act through the agency of the vaso-motor nerves, supplying the seat of the hyperæmia; but may be mechanical, as a blow, etc.; physical, from the action of heat or cold; or vital, from defect in the condition of the blood, nerves, secretions, etc.

Symptoms.—1. Bright redness. 2. Increased heat. 3. Swelling. 4. Pain, of an itching, pricking, throbbing, or aching character. 5. Altered sensibility. 6. Augmented functional activity.

Results.—1. Resolution. 2. Inflammation. 3. Induration. 4. Hypertrophy. 5. Passive congestion.

Treatment is the same as that of the preliminary stages of inflammation.

Passive Congestion is the accumulation of an undue quantity of dark blood moving slowly through a part. The excess of blood is chiefly in the veins, the arteries being mostly of their normal size.

Causes.—1. Gravitation, as shown in chronic exhaustive and acute febrile diseases, when the lungs and integuments of the back are affected; this is generally associated with the next cause. 2. Diminished cardiac power, and loss of tone in the vascular system, as seen in old age, etc. 3. Any mechanical obstruction to the return of venous blood, e.g., a tight bandage, strangulated hernia,

and paraphimosis by reason of one part of the body tightly nipping another, pressure of growing tumours, formation of cicatrices, large collections of serous fluid in the chest or abdomen. 4. Inflammation occasionally.

Symptoms.—1. The part is dull red, cooler than usual, a little swollen,—not locally, as in active hyperæmia, but soft, and pitting on pressure all over, running into healthy tissue. 2. The sensibility is lowered, the site affected, being benumbed and stiff. 3. The functions are impaired.

Consequences.—1. Transudation of serum, due to the vessels relieving themselves of the watery constituents of the blood by their passage into the surrounding cellular tissue, thus producing œdema and dropsical effusions. 2. Hæmorrhage. When the obstruction is very great, and the walls of the vessels weak, they give way, blood being poured out superficially or extravasated. 3. Fibroid induration. 4. Stasis when the circulation is completely arrested. 5. Gangrene. 6. Thrombosis.

Treatment.—The part should be raised slightly; if elevated too much, the vitality being already lowered, more harm than good will result. All restrictive bands or other mechanical obstruction must be removed. Gentle friction. Warmth by means of cotton wool or absorbent cotton. Judicious support with a bandage. Astringents.

Inflammation is defined by Burdon

Sanderson as the "succession of changes which occurs in a living tissue when it is injured, provided the injury is not of such a degree as at once to destroy its structure and vitality." The process has been studied very carefully with the microscope in the web of the frog, the wing of the bat, etc., and is briefly as follows. 1. Disturbance of nerve action, and effects on blood-vessels. On the application of an irritant the sensory nerves of the part are stimulated, causing in a reflex manner a sort of paralysis of the vaso-motor nerves, leading to dilatation of the vessels and accumulation of blood in them. This is generally preceded by contraction of the vessels, but in that case the dilatation follows almost immediately, the arteries, capillaries, and veins succeeding each other in that act. 2. Determination of the blood to the part. The blood passes more rapidly, in spite of the calibre of the vessels being increased. This is certainly due to nervous influence, though the exact mode of working is unknown. 3. Congestion. The blood begins to be variable in motion, and soon gets slower, until it is finally arrested (stagnation or stasis). 4. Passage of the contents of the vessels through its walls. When the blood stream slackens, the white corpuscles begin to accumulate on the walls of the vessels, and proceed unusually tardily; fresh ones overtake those moving more slowly, and thus they appear in greater number. Soon, owing to an alteration of the walls of the capillary and of the tissues outside, the white corpuscles show a tendency to stick to the walls of the vessel; the blood having become more viscid as the result of transudation of the liquor sanguinis through the capillary wall. The white corpuscles themselves now traverse the walls of the capillaries by means of an amœbiform movement (diapedesis), and collect in groups external to the vessel; the red corpuscles, by intravascular pressure, are also driven through the minute openings made by the white. 5. Changes in the perivascular tissues. The lymph spaces of the tissues around abound in fixed corpuscles, consisting mainly of protoplasmic material. These assume a state of exalted nutrition, when stimulated by the transudation of the blood, and multiply by cleavage, forming amœboid cells, whilst at the same time their nuclei enlarge. The exudation of serum con-

taining albumen, plasmin, and fibrinogen unites with the globulin of the surrounding cells to form fibrin. Mucin is also present in some quantity, derived from the blood or cells. As the result of inflammation, the special functions of the tissue are usually damaged; thus the connective tissue softens (mucoid softening), its fibres being destroyed, ligaments and tendons become soft and swell, bone loses its lime salts, and the lamellæ disappear; the cartilages diminish in consistency, with liquefaction of the matrix. In brief, the tendency is to return to an embryonic condition.

Causes.—Predisposing. 1. Previous inflammation inclines an organ to have a similar attack. Various parts in different individuals are more susceptible than others to inflammation. 2. Over-use of a part, as in inflammation attacking the breasts of mothers whilst nursing, and inflammatory affections of the larynx, arising from excessive or unusual exercise of the voice in singing or speaking. 3. Occupation has a certain influence; e.g., the baker and tailor become anæmic, and prone to have glandular inflammations.

—Constitutional. 1. Robust, strong, plethoric persons, and those who habitually over-eat, or over-use alcoholic drinks, are susceptible to sthenic inflammations, their blood being loaded with effete materials, or, in some cases, with urates, as in gout. 2. On the other hand, weakly persons, and those debilitated by chronic inanition, exhaustive diseases, and old age, are liable to the asthenic variety. 3. Hereditary predisposition, as in gout, rheumatism, syphilis, struma, etc. 4. Defective blood states, as in carbuncle, boils, Bright's disease, anæmia, diabetes, etc.

—Exciting. 1. Mechanical, as the result of bruises, squeezes, cuts, wounds, injuries to joints or bones, etc. 2. Physical: excessive cold or heat, producing burns, scalds, etc. 3. Chemical: mineral salts, alkalis, acids, alcohol, ether, essential oils, cantharides, mustard, turpentine, etc. Most of this group are used by the surgeon as therapeutic agents. The action of putrid matter in producing inflammation in some cases depends on an alkaloid poison of chemical origin, as in septicæmia. 4. Organised irritants of the nature of microscopic fungi, with their germs. This class includes erysipelas, anthrax, hospital gangrene, smallpox, syphilis, and many other diseases. 5. Altered state of local

nerves, as in inflammation of cornea, subsequent to injury of fifth nerve. 6. Foreign bodies introduced from without, or formed within the body, as retained concretions, excretions, sloughs, sequestra, bullets, calculi, etc.

Symptoms.—1. Heat. 2. Redness. 3. Swelling. 4. Pain. 5. Impairment of function.

1. Heat. An inflamed part is hotter than normal. This is produced by augmented amount of blood and increased activity of chemical changes in the tissues, together with abundant growth of organised matter. The newly-formed products and the old are wasted, and it is this waste which causes the heat.

2. Redness is mainly due to the enlargement of the small arteries, veins, and capillaries of the part. The tint varies from crimson to a dull claret colour. The exudation of red corpuscles, or the colouring matter of the blood, will assist in producing the redness.

3. Swelling is at first dependent on the increase of the blood in the part, but afterwards on the transudation of the blood, and the multiplication of the cellular elements. Inflammatory swelling is distinguished by its hardness.

4. Pain is the result of increased excitement of the nerves, at first, owing to the exalted nutrition of the part; next, to pressure by the exuded matters. It varies in degree, but is greatest in firm and unyielding structures, as ligaments, bone, and fasciæ.

5. Impairment of function always accompanies inflammation. This is well exemplified in the great intolerance of light exhibited by the eye in inflammation of the cornea.

Terminations.—1. Resolution, which is the most favourable issue that can occur, and is said to take place when the inflammation wears away. The temperature is lowered, and the blood-vessels return to their normal state, the parts restoring themselves in an inverse order to that of their invasion. The exuded products are chiefly absorbed by the lymphatics.

2. Metastasis. This is a sudden disappearance of the inflammation from one part and its re-appearance in another, as in an orchitis succeeding inflammation of the parotid gland.

Constitutional Symptoms always assume the form of fever (traumatic or inflammatory fever), and vary much in their

intensity, according to the importance of the situation affected, the extent of the inflammation, its severity, etc. "In most cases of fever, and probably in all cases of serious fever, there is a definite poison circulating in the blood, the poison sometimes having been formed in the system, sometimes having entered the organism from without." There are three forms: 1. The sthenic. 2. The asthenic. 3. The irritative.

1. The sthenic form occurs in acute inflammations and robust constitutions. It generally commences within twenty-four hours from the onset of local symptoms. There are restlessness, loss of sleep, pains in the back and head, chilliness or over-heat; the pulse increases in frequency and force or sharpness, the skin is hot and dry, the mouth is parched, tongue furred, appetite lost, and nausea, with vomiting, may be present. The patient craves more and more for water. Constipation or diarrhœa, with black, fetid evacuations, are associated. Urine is high-coloured, scanty, and loaded with uric acid. Temperature is raised several degrees, but rarely exceeds 102·5 Fahr. The termination is by a crisis, in from thirty-six hours to seven days, various evacuations, as sweating, diarrhœa, etc., relieving the blood of its effete materials. There is a decided tendency to spontaneous and complete recovery.

2. The asthenic variety occurs in weak, ill-nourished, broken-down states of the system; it is characterised by great depression slowly followed by reaction. Delirium, especially at night, of a low, muttering kind, pulse feeble though hurried and easily compressible, skin hot, tongue dry, harsh, and brown, are symptoms usually met with. In addition, fauces are dry, sores occur on lips and teeth, cheeks are flushed, and eyes unusually bright. It terminates by lysis, or in unfavourable cases by death from exhaustion or low congestive inflammation of viscera.

3. The irritative usually presents itself in constitutions weakened by excessive use of alcohol. The symptoms are severe, at first resembling the sthenic, but there is more delirium; soon this is succeeded by a decline into the asthenic, the exhaustion being very marked, and the patient sinking from prostration with cerebral irritation.

Sequela.—1. Induration, due to chronic

inflammation. 2. Hypertrophy of a part from enlargement of its own elements. 3. Hyperplasia by the addition of new elements. 4. Suppuration. 5. Degeneration. 6. Ulceration. 7. Gangrene.

Varieties.—Inflammations are classed in several ways. 1. According to their duration, into rapid or acute, slow or chronic, intermediate or subacute. 2. Their intensity, hypersthenic or very strong, sthenic or strong, asthenic or feeble. 3. Their special characteristics, phlegmonous or healthy, adhesive, suppurative, ulcerative, gangrenous, rheumatic, gouty, syphilitic, fibrinous or plastic, etc.

Treatment.—Local. 1. Abstraction of blood by dry cupping or scarification, in inflammation of the prostate gland, glottis, conjunctiva, eyelids, skin, etc. Leeches in acute sthenic forms of inflammation occurring in healthy persons, as in orchitis along the cord, or when the eye is affected. They must not be applied to parts abounding in loose cellular tissue, *e.g.*, the eyelids or scrotum, as the bleeding cannot be stopped by pressure, and erysipelas is apt to follow.

2. Incisions are used to prevent sloughing in inflammation of the cellular tissue and in threatened strangulation, being made through the fascia to relieve the subfascial covering. They vary in extent from incisions four or five inches long to mere punctures, in accordance with the requirements of the case. Opening the scrotal veins is of use in orchitis.

3. Stoppage of, or lessening, blood supply of an inflamed part by digital pressure, ligature, or acupressure of main artery, is useful in injuries of large joints.

4. Remove all causes of irritation, all foreign bodies, as shot, dust, etc., or carious teeth from the jaw.

5. Position.—The patient should be put to bed if the trunk is inflamed, to afford rest to the part, and to the nervous system, brain, heart, and respiratory organs; the head must be elevated if the brain is inflamed, and so on. The principle is to rest the heart as much as possible, and prevent too active circulation through the locality affected, and at the same time to assist the return of blood and diminish congestion.

6. Applications.—Cold, by exposure to the air, by evaporating lotions (as

nitre ʒss, sal ammoniac ʒij, vinegar or methylated spirits ʒjss, water Oj), irrigation, ice or cold-water bags for the head, or incarcerated hernia—it is advisable to place an intervening layer of flannel between the bag and the skin, to avoid freezing the part—ice poultices, Leiter's coils, etc. Cold must only be employed in the early stages, before exudation takes place, and where tissues were previously healthy, *e.g.*, not in rheumatism, gout, or struma. The action of cold must be continuous, or reaction will ensue. A good plan is to begin with tepid water, and gradually use it cooler and cooler, finally mixing ice with it. Cold constricts the vessels, lowers the nutritive activity of the tissues, prevents the formation of new cells, and stops their amoebiform tendency. Cold is very effective also in restoring tone to the tissues after an inflammation. Heat, by covering the part with cotton wool covered with oil silk, hot poultices of linseed, bread, starch, etc., hot water (in compound fractures), spongio-piline, local warm baths. Poultices should never be applied unless covered with oil silk or guttapercha tissue, as after a time they become merely a cold-water dressing, and inflict pain. Heat is most successful when the inflammation has reached a certain height, easing tension, ripening the pus, and relieving the nerves, removing their excitability. It also stimulates the absorption of liquid and solid effusions by the lymphatics and blood-vessels.

7. Simple compression by collodion in the case of fingers and the like, in other instances by cotton wool, or absorbent cotton with bandaging, elastic bandages, shot bags, compressed sponges, strapping, etc.

8. Surgical rest applied to a part locally, as an inflamed joint, by means of splints of wood, wire, zinc, millboard, starch, leather, poroplastic, plaster of Paris, etc.

9. Various topical applications to prevent the formation of pus or for purposes of cleanliness, permanganate of potash, carbolic acid, perchloride of mercury, iodoform, iodine, etc.

10. To relieve pain, solutions of opium, morphia, belladonna, conium, aconite, veratrina, etc., or subcutaneous injections.

11. Counter-irritation applied at some distance from the part affected by iodine

(tincture or liniment), acetum lyttæ, nitrate of silver solution, mustard poultices, turpentine, chloroform, and ammonia. These act chiefly on the cutaneous nerves, but also help to draw the blood away from the seat of disease.

12. To promote absorption of blood, arnica, hydrochlorate of ammonia, and spirits of wine are of service. Iodide of potassium and acetate of ammonia are efficient remedies.

13. To produce disappearance of induration, mercury is all-powerful, so long as the induration is not of the nature of a new growth or tumour. When the inflammation is chronic, cold douches, followed by active friction, or friction with glycerine, oleates of mercury, or local stimulants, as the ammonia, camphor, and chloroform liniments. Methodically applied massage is of use. Issues, setons, and the actual cautery are great aids in long-standing cases.

Constitutional Treatment.—In sthenic cases, general blood-letting has almost entirely been banished from modern practice; its use is now confined to cases in which internal viscera are compromised, as in wounds of the lung and severe injuries to the head, provided the patient is young and healthy. This measure should only be practised on adults; the quantity of blood abstracted should vary from eight to sixteen ounces, or more, until a decided impression is made on the pulse. When bleeding is necessary the earlier it is done the better. The skin, kidneys, and bowels, the three great eliminatory channels, must be regulated by means of diaphoretics, diuretics, and purgatives. To produce sweating, the following may be used:—Jaborandi or its alkaloid pilocarpine, antimonials, liq. ammon. acetatis, pulv. ipecac. co., and sp. æth. nit., etc., aided by plenty of hot drinks. Packing the patient in a blanket wrung out of hot water is a powerful aid to this treatment; the vapour bath is also of service.

As diuretics, the citrate, nitrate, acetate, or tartrate of potash are useful in increasing the solid matters in the urine; colchicum produces addition of water to the urine.

Purgatives are in most cases necessary, as pil. hydrarg. subchlor. co. gr. v, or calomel gr. iij to v, followed by

salines, a good prescription being the following:

℞ Infus. sennæ ʒij.
Magnes. sulph. ʒij.
M. for one dose.

Other cathartics, as castor oil, cascara sagrada, magnesia, rhubarb, or jalap, simply act by emptying the bowel; when an irritating effect is wished for, colocynth, scammony, gamboge, podophyllin, euonymin, and aloes should be used. Sulphate of soda is a valuable laxative. In certain cases, where constipation is very obstinate, croton oil or elaterium may be cautiously given. Injections or enemas are powerful auxiliaries in clearing out the lower bowel. They may be prepared of gruel, castor oil, spirits of turpentine, soap and water, etc. The most important point is to throw in a sufficient amount to distend the bowel. Depressants act in a similar manner to general bleeding. Foremost among these must be placed antimony, in the form of the wine; the value of this medicine cannot be overrated in all inflammatory affections in the young and robust; it is best given with small doses of opium or morphia. Digitalis is of great service in children or the aged, as it strengthens the heart's action whilst slackening the beats. Aconite in one minim doses frequently repeated is very successful in simple inflammations, provided it is used sufficiently early. Tinctura veratri viridis is another powerful arterial sedative. To lower the temperature, large doses of quinine (gr. x to xx), or salicylic acid, seem the most trustworthy, but antipyrin is useful.

To quench the thirst effervescing salines are necessary—soda or potash water with lemon juice, ice sucked in small pieces, etc.

To relieve pain and procure sleep, opium, morphia, belladonna, atropine, hyoscyamus (especially for children), Indian hemp, chloral, bromides of potassium or ammonia, hydrobromic acid, are all valuable. I have found the best form is to combine the opium with belladonna or hyoscyamus. Morphia is best given united with atropine as a subcutaneous injection. Chloral with the bromides, flavoured with syrup. aurantii, is a useful narcotic. Indian hemp is to be recommended in cases where opium is ill borne.

Diet.—It is useless to try and feed

up the patient, a spoon diet, as milk and water, or peptonised milk, being the most suitable, and as the case progresses this may be amplified. In the asthenic and irritative forms a stimulating plan of treatment is required, all lowering measures being prejudicial; ammonia, ether, bark, quinine, perchloride of iron, wine, brandy, eggs, milk, with strong beef tea, must be freely used after the first onset. In these cases the patient must have food in small quantities, but frequently, *both day and night*. In the irritative form opium is of cardinal importance.

Complications, as pneumonia, etc., must be treated after the usual method, as they arise.

The following formulæ for the preparation of subcutaneous injections may be of service.

1. Subcutaneous injection of pilocarpine mij to vj , of a solution of gr. j of

nitrate of pilocarpine in mxx of distilled water.

2. Solution of morphia for subcutaneous injection. Take a 3j stoppered bottle, half full of water, put in gr. xl of acetate of morphia and drop in miv of acetic acid (B.P.). Shake, then fill bottle with water. Dose, mij to vj .

3. Solution of atropine for subcutaneous injection. Take a 3j stoppered bottle, put in gr. ij of sulphate of atropine, and fill up with water ($\text{mij} = \text{gr. } \frac{1}{240}$). Dose, mij to vj .

4. Solution of atropo-morphine for subcutaneous injection. Add gr. ij of sulphate of atropine to 3j of morphia solution (*vide supra*). $\text{mxiij} = \text{morphia gr. j}$, and atropine $\text{gr. } \frac{1}{20}$. Dose, mij to vj .

The atropine increases the hypnotic and anodyne effects, but counteracts the depression which morphia is apt to cause.

CHAPTER II.

SUPPURATION—ACUTE AND CHRONIC ABSCESS—SINUS AND FISTULA.

Suppuration is one of the most common sequelæ of inflammation; the process consisting in the formation of pus on the surface, or in the substance of tissues. It will be readily understood that those structures which contain the greatest amount of loose cellular connective tissue will be most liable to suppurate.

Pus, as seen microscopically, is composed of an abundance of white corpuscles from $\frac{1}{2500}$ to $\frac{1}{3500}$ of an inch in diameter, floating in a clear homogeneous fluid. Pus cells are seen in different conditions, according to their age; at first assuming constant changes of shape, but after a time settling down into a spherical form, and presenting to view one or more nuclei in the centre. They are granular from infiltration with fatty and albuminoid particles; the addition of acetic acid makes them swell up and become clear, thus rendering the nuclei distinct: ammoniacal solution of carmine will stain the cells a deep colour. To distinguish mucus from pus the microscope is most reliable; mucus floats in water,

coagulates on the addition of acetic acid, is unaffected by liquor potassæ, if treated by ether only gives faint traces of fat, and is unaffected by Day's test. The process of the formation of pus will be readily understood from our sketch of inflammation. The liquid is merely the transuded liquor sanguinis, whilst the pus cells are chiefly the emigrated white corpuscles, increased in number by multiplication, but also due, in some measure, to the augmented activity of the surrounding connective tissue corpuscles.

The greater the severity of an inflammation, the more extensive will be the migration of white corpuscles with the formation of pus, and the sooner will the formation of matter commence. Pus cells seem endowed with the property of irritating the adjacent tissue, causing multiplication and proliferation of cells. Thus by softening and liquefaction the area of mischief is increased.

Characters of Pus.—Pus is a yellowish coloured fluid, with a light tinge of green, of a diffuent or creamy consistence,

alkaline reaction, and faint odour. Sp. gr. 1020 to 1040; it is insoluble in water, and is coagulated by heat, acids, or hydrochlorate of ammonia; with liquor potassæ it forms a viscid gelatinous mass.

Dr. Day's Test for Pus consists in adding a very little water to a fluid supposed to contain pus, and then a few drops of a liquid prepared by exposing to the air an alcoholic saturated solution of guaiacum, until it acquires the property, by the absorption of oxygen, of assuming a green colour when brought into contact with iodide of potassium. If pus, however small in quantity, be present, a blue colour will be produced. The test liquid should be kept in the dark, in a well-corked bottle. Pus coagulates soon, forming large clots of a whitish or yellowish colour, which consist of altered pus corpuscles, entangled in fibrin. It contains myosin, paraglobulin, protagon, fatty acids, leucin, tyrosin, and the same materials as the serum of the blood—i.e., water, chloride of sodium, albumen, mucus, extractive matters, and fat. When mixed with blood it is termed sanious, and is of a brown colour; when there are few cells, ichorous; if containing clots, curdy; sero- and muco-pus are a mixture of serum or mucus with pus. In some cases pus cells undergo fatty degeneration, forming what are called compound inflammatory corpuscles; in chronic abscesses the pus cells shrink, becoming angular. Pus also contains different matter according to its locality; as in the liver, liver cells; in the brain, white fibre corpuscles; in bone, lime salts and minute sequestra. Micrococci are usually present in pus excluded from the air, bacteria or bacilli in pus exposed to the atmosphere.

Symptoms.—Suppuration may occur either on the surface or in the interior of the body. When occurring on a mucous surface—which is very prone to suppurate—the membrane becomes red, hot, swollen, painful, and there is a discharge. If suppuration takes place internally it forms an abscess: there is throbbing, pain, increased hardness with swelling, the skin is red and shining, terminating in softness with fluctuation. In other cases there may be no pain or inconvenience, but merely swelling with fluctuation.

Constitutional assume the form of suppurative or hectic fever. This never occurs

unless there be a *discharge* of pus, and is due to the absorption of decomposing matter containing micrococci. The symptoms of hectic fever are conveniently arranged in four periods.

Premonitory Stage.—Sense of fatigue and weakness on waking, distaste for breakfast, rapid and small pulse.

First Stage.—Loss of flesh, pulse quick, weak, and small, any excitement raising it ten or twenty beats. Skin dry, and becomes hot in the evening, with a burning sensation of the hands and feet, although the patient feels chilly. The temperature rarely exceeds $103^{\circ} 5'$. At night during sleep, and towards the early morning, there is profuse sweating (colliquative), with a fall of temperature, but the pulse maintaining its frequency. Tongue is red at the top and edges.

Second Stage.—Emaciation progresses. Hectic flush appears on the cheeks in evening. Eyes are bright and sunk in the orbit. Fever and sweatings more marked. There is often diarrhœa. Urine after sweating contains increased quantities of urea, chloride of sodium, sulphuric acid, and water. The patient is restless and excitable, sometimes delirious, though the intellect, as a rule, is clear to the last. Muscular system is exhausted, voice and hands tremulous, appetite variable and capricious.

Third Stage.—Pulse feebler and more rapid, skin dry and scaling, urine offensive, mouth aphthous, diarrhœa, chills, and sweats more frequent, and legs become œdematous. Bed sores are apt to form. Emaciation is now extreme, the joints appearing larger than the middle of the limbs. The temperature falls below normal in the morning. The liver and spleen may enlarge from lardaceous disease, and the urine contain hyaline casts from the kidney.

Treatment.—Warmth applied by poultices, spongio-piline, sponges wrung out of hot water, fomentations, warm baths. Extr. belladonn. ʒij with glycerin. f. ʒj is a very soothing and useful application when smeared over the affected part. It is important that there should be no compression over the suppurating site, which must be dressed, loosely and lightly. Counter-irritants applied over the principal vessels leading to the diseased place seem often to have a good effect in moderating the suppurative action. For muco-purulent discharges,

astringents, as liq. hydrarg. perchlor., vin opii, tannic acid, sulphates of zinc, iron, or copper, etc., are essential.

Constitutional.—In the early stages, moderate diet, nothing being better than milk with soda water, or peptonised milk, no stimulants, purgatives if necessary, and diuretics if the kidneys are sluggish. As the disease proceeds and a discharge appears, the diet must be increased; the strongest possible liquid food being given at frequent intervals, if solid food be refused. Stimulants, as brandy, champagne, etc.; tonics, quinine and sulphuric acid, nitro-hydrochloric acid dil. with nuxvomica, ol. morrhue, iron and strychnia. The sweating of hectic must be controlled by giving very little fluid at night, keeping the bed and clothing as cool as possible, abundance of fresh air, and sponging body with hot vinegar and water. Zinc oxide gr. iv to v in a pill, combined with ext. belladonn. gr. ss, is also useful, or atropia may be administered hypodermically. It is of the utmost importance to feed the patient during the night as well as the day. To check the diarrhoea, astringents, as pulv. kino co., bismuth, opium, sulphate of copper, nitrate of silver, lead, etc., are necessary. A water bed is frequently required.

Abscess is a collection of pus in the interior of the body. Abscesses are found in every known vascular tissue, and also in the cornea and in cartilage. Almost all acute abscesses contain micrococci, even those caused by the injection of irritating but *aseptic* materials. These micrococci do not necessarily give rise to putrefaction. Round about an abscess there is a layer of plastic lymph, constituting the wall of the abscess, but varying in thickness and consistence (pyogenic membrane). The period at which suppuration commences after the initiatory symptoms of inflammation varies from twenty-four hours to three or four days.

Acute Abscess.—Symptoms. When an abscess is forming the part is the seat of pain, generally of a throbbing character, synchronous with the pulse at the wrist, and worse in the dependent position; the skin becomes red and glazed; the swelling localised; slight œdema is also present, recognised by the place pitting on pressure with the finger; at length tension and fluctuation are superadded.

This latter sign is made out by pressing gently with the tips of the fingers alternately on opposite sides of the abscess; as the fingers on one side sink in, the other fingers are raised. Another way is to make percussio with one hand, the other being placed on the opposite side. In certain situations, as the breast, the skin is stretched over the swelling by the tumour being grasped with the thumb and forefinger, and the other index finger pressed on the top of the supposed abscess. Fluctuation is obscure in a deep-seated abscess, the tissues above merely appearing brawny, œdematous, and perhaps reddened. As a universal rule, in all cases where a doubtful swelling is supposed to be an abscess, use an aspirator or a grooved needle to solve the uncertainty. The gradual formation of more pus distends the parts, makes them thinner, and separates the least resisting tissues, the pus having a special inclination to make for a free surface. As the abscess becomes more superficial the centre of the skin immediately over it assumes a bright red colour, shading off into the surrounding tissue, and this gradually changes into a yellow hue, the abscess being said to point. As a final result the skin gives way and the abscess discharges itself. The enveloping vascular wall (pyogenic membrane), relieved from tension, falls into folds and collapses by the elasticity of the surrounding tissues. New material is formed on the wall of the abscess, disposed in the shape of granulations, made up of new cells in a scanty ground substance and loops of blood-vessels, until the cavity is filled, and then cicatrization takes place, healing over the opening. Although this is the usual course of events, it is to be remarked that pus is capable of being absorbed in any locality.

Constitutional Symptoms are termed *Primary Suppurative Fever*. Rigors alternating with flushes and sweats; muscular pains; pulse full, strong, and frequent; hot dry skin; urine scanty, high-coloured, and loaded with uric acid; restlessness and great thirst; delirium is often present in severe cases. Temp. usually about 103°.

Varieties.—1. Diffuse abscess. This term is applied when the pus, instead of endeavouring to reach a free surface, spreads up and down in the cellular tissues of a part, there being little or

no limiting wall. An example of this is the puerperal abscess which occurs in women after childbirth.

2. Metastatic abscess. In this case the abscess changes its locality, generally owing to the transference of septic matter by means of the blood.

3. Recurrent abscess. This denotes that an abscess has commenced to subside, inflammation again occurring with the re-formation of pus—a not uncommon result in abscesses of the ischio-rectal fossa.

Treatment may be considered under three heads. 1. Make a free opening in a dependent position. 2. Drain efficiently. 3. Prevent decomposition by aseptic treatment.

1. As a general rule the matter should be let out as soon as detected, but this is of special moment when it approaches important regions, where it might burrow, as the popliteal space, or ischio-rectal fossa; if in the neighbourhood of vital organs, as in the abdominal wall; when situated in the sheath of tendons (thecal); if located in proximity to a joint; in abscesses of the neck, causing dyspnoea; in collections of purulent matter under the periosteum; lastly, in extravasations of urine and post-pharyngeal abscess. The opening should be made early, also when it is desirable to leave as unsightly a cicatrix as possible; for instance, in the neck or face.

The methods of opening an abscess are—(α) Incision. (β) Aspiration. (γ) Caustics.

(α) Incision is performed by using a sickle-shaped or long straight narrow knife, held short, and both introduced and withdrawn perpendicularly to the surface. The point opened should be the most dependent where fluctuation is apparent, and the aperture should be sufficiently free to allow of the escape of the contents without pressure being applied to the abscess wall. It is important to remember that in large abscesses the vessels adjacent are often pushed into unusual situations; so before incising an abscess it should be the surgeon's care to feel for pulsation in the proposed line of incision. Should the abscess be of much extent a counter opening is to be made, by either at once plugging the first cut with the thumb, or introducing a probe and cutting down on its projecting knob. In deep-seated

abscesses, such as occur under the sterno-mastoid, Hilton's method should be used. An incision is made through the skin, a director passed through this and pushed into the abscess, then a pair of dressing forceps is introduced along the groove of the director and the opening dilated.

(β) Aspiration is used in large deep-seated abscesses to avoid the entrance of septic organisms contained in the air, and so, without risk, to diminish their size.

(γ) Caustic is rarely used, except in certain cases of suppurating buboes, the skin being undermined and its vitality low. The caustics generally employed are potassa fusa or potassa cum calce. To limit the action of the caustic a hole should be cut in a piece of plaster, the size of the intended opening, and placed over the abscess before the application of the escharotic.

2. Drainage is of paramount importance, and some form of drainage tube should be inserted (*vide* chap. x.).

3. The aseptic treatment, if it can be used with all the requisite attention to its details, will well repay the surgeon's extra trouble; but if this is not available an antiseptic or modified aseptic plan should be adopted (*vide* chap. x.).

After-treatment.—After an abscess has been opened, and a drainage tube inserted, an aseptic poultice, made by mixing iodoform or boracic acid with linseed, or medicated water or oil dressings, should be applied. The chief points to be attended to are irrigation of the abscess cavity, two or three times a day, with diluted iodine or alcohol, fixation of the part affected by splints or bandages, and approximation of the sides by compresses.

Chronic Abscess usually depends on some diathesis, and is symptomatic of disease in a bone, joint, or gland. In such cases the abscess forms slowly and insidiously, without pain or heat, often not attracting attention by any symptom but its size. The contents of these abscesses are thin, curdy, and watery; as they do not readily point their duration is indefinite, in some cases extending over years. There is no redness until the skin is involved, and as the abscess wall is generally very thick fluctuation may be indistinct. Strumous individuals are most frequently affected, and in such persons the affection is often multiple. Chronic abscesses are liable to be confounded with bursæ and cysts. From the

former the position will generally suffice to distinguish them; from the latter the want of translucency; but in all doubtful cases it is as well to confirm the diagnosis by puncturing with the aspirator or grooved needle.

Varieties.—1. Gravitation abscess. 2. Tympanitic. 3. Residual.

1. Gravitation abscesses, or abscesses by translation, usually have their origin in diseased bone, but not always. Diseases of the vertebræ, upper and lower ends of the femur, ileum, and sacrum are constant causes of this disease. These abscesses travel a considerable distance before pointing; *e.g.*, in disease of the dorsal vertebræ the pus enters the psoas sheath, pointing in the groin.

2. Tympanitic abscesses contain gas as well as pus, and are resonant on percussion. They usually exist where the cavity of an abscess communicates with, or is adjacent to, the intestine. On being opened they emit a strong fœcal odour.

3. Residual abscess occurs in chronic disease of a joint which is apparently recovering, and is due to a breaking down of old inflammatory effusions, which have not been absorbed.

Treatment.—Chronic abscesses, if large, when opened and exposed to the air are liable, from the action of micro-organisms, to decompose, and thus prove fatal to the patient, either from blood poisoning or profuse and long-continued discharge. To avoid this the older surgeons were in the habit of using valved openings, by drawing the skin covering the abscess aside, opening it, and before the pus had finished flowing allowing the skin to slip back again. This method, however, is quite useless.

In treating large abscesses two plans may be used—1. Aspiration. 2. Strict aseptic treatment.

1. Draw off the contents with an aspirator, and inject through the aspirator needle an emulsion, composed of iodoform ʒiij , with glycerine ʒiij . One ounce of this solution is injected, and the puncture dressed with iodoform gauze and bandage, firmly applied.

2. Aseptic treatment can be adopted at once, or abscess first reduced in size by aspiration. The abscess should be opened freely under the strictest precautions (*vide* chap. x.).

If the abscess be smaller it may be opened aseptically, and the granulations

lining its cavity be removed by a Volkmann's sharp spoon, and then washed out with chloride of zinc solution, gr. xl to ʒj .

When the skin is much congested and implicated potassa fusa may be applied. Offensive discharge is best corrected by injecting, twice a day, into the cavity, half an ounce of a mixture of iodoform gr. xx, spirits of wine ʒj . Drainage tubes are of immense service, both in preventing the accumulation of matter and in stimulating the cavity to close. Occasionally it is necessary, in order to promote the healing process, to dissect an elliptical piece of skin from the face of the abscess.

The after dressings must be stimulant, and the constitutional treatment supporting.

Hæmorrhage into the Cavity of an Abscess may occur—1. From the vascular living wall. This is soon stopped by cold and the pressure of a pad with a carefully-applied bandage. 2. From an adjacent vein being involved. The rule here is to plug the cavity with strips of lint, soaked in liq. ferr. perchlor. fort., and apply a bandage. The result is often fatal if the vessel be a large one. 3. From the opening of an artery in juxtaposition with the abscess. In this case compress the vessel by the finger or tourniquet, lay open the cavity, tie the bleeding vessel above and below the communicating aperture, and divide it between the ligatures. If the vessel cannot be found the proper course is to cut down on and tie the main artery.

Sinus and Fistula.—A sinus is a passage, often tortuous, leading into the soft parts, the remains of an unclosed abscess, or, more rarely, following wounds or ulcers. When the passage communicates with a mucous canal, as well as with the exterior, it is termed a fistula.

Causes are anything which hinders the healing process, as irritation from dead bone, a foreign body, etc.; the passage over its surfaces of excreta, as urine or fæces; want of rest from the contraction of muscles; mechanical obstruction to the free evacuation of matter; defective health.

Treatment.—Remove as far as possible all sources of irritation, attend to the general health, and then try to promote the closure of the sinus or fistula from the bottom. The means used are compresses of lint with a well-applied

bandage, injections of iodine, sulphate of zinc, chloride of zinc, sulphate of copper, or nitrate of silver. A useful injection is the Liqueur de Villate:—

R Zinci sulphatis, cupri sulphatis ā ā
gr. xv.
Liq. plumbi subacetatis f. ʒss.
Acid acetic. Dil. ʒiijss.
Misce.

Passing an elastic ligature or drainage tube of caoutchouc, spiral wire, or bone

quite through the passage. Coating a probe with nitrate of silver, and plunging it rapidly down so as to reach the distal end of the sinus and cauterise it from the bottom outwards. Paquelin's thermo-cautery or the galvanic cautery. Dilatation by sponge or laminaria tents. As a final resource, laying the sinus completely open with a blunt-pointed bistoury, and dressing it from the bottom. Plastic operations are often necessary.

CHAPTER III.

ULCERS, AND HEALING BY GRANULATION.

ULCERATION is the melting away of tissues in a molecular manner, depending usually on inflammation, and attended with the discharge of a purulent fluid. It occurs most frequently in vascular tissues, but non-vascular ones, as the cornea or cartilage, are also liable to be affected. Ulceration always occurs on the surface, or a pseudo-surface, as the lining membrane of the stomach, and is most common on the skin and mucous membranes. When ulceration takes place in the skin there is preceding inflammation, with transudation of serum and diapedesis of leucocytes. The irritation of the exuded products occasions increased proliferation of the cells of the cuticle; the new cells are soft and easily separated by slight friction, leaving the dermis exposed. The tissues beneath, by the multiplication of the leucocytes, and by softening of their elements, also undergo degeneration, and are cast off in minute particles, forming the discharge. It is in this way the ulcer increases in extent and depth. If the ulcer is a sequence to a new growth, the process is similar, the cells of the new growth acting the same part as the leucocytes.

Causes.—Predisposing. 1. Feeble vitality from impaired circulation, as in aged persons, general obesity, diseases of heart, bronchitis, emphysema, etc. 2. Long-standing congestion of a part. 3. Malnutrition, as in struma, gout, anæmia, scurvy, etc. 4. Alteration or defect in the nerve supply of an area.—Exciting. 1. Acute inflammation of a part. 2. Chronic inflammation. 3. Fol-

licular inflammation. 4. As a sequence to a vesicle or pustule, *e.g.*, the ulcers which occur after ecthyma or pemphigus. 5. Suppurative inflammation in subcutaneous and submucous tissues, the skin being undermined and its vitality extinguished. 6. By mechanical injury, pressure of an irritant, etc. 7. As a sequel to new growths, as lupus, or a tumour. 8. Specific poisons, as in syphilis or typhoid fever.

Situation.—As a result of injury an ulcer may form anywhere, but when there is a specific cause the sore is generally situated in a particular locality, as the penis in soft chancres. The most common site is the lower half of the leg, generally occurring in the poorer classes after the middle of life is passed. In this situation the ulcer is very stubborn to treatment.

The Process of Ulceration may be conveniently divided into three stages—1. Extension. 2. Arrest. 3. Repair.

1. *Extension.*—A typical spreading ulcer presents an irregular base, covered with a greyish or yellowish, soft, pulpy, dirty slough; a margin steep and often inverted; a discharge of purulent fluid mixed with the debris of broken-down tissue, or perhaps stained with blood from the minute vessels; and lastly, pain of a burning, throbbing character. There is a pinkish circle round the ulcer from inflammation.

2. *Arrest.*—The inflammatory symptoms subside; there is less pain. The surface begins to clear, the slough disappearing in the discharge, which be-

comes more like laudable pus, and is no longer mixed with débris. Edges are hard and elevated, but not painful, except when the delicate nerve filaments are entangled. The surface, however, remains smooth, covered with small unhealthy granulations, whilst there is no process of filling up. Lymph is deposited in the tissues of the base and sides of the ulcer.

3. Repair.—Edges are gradually sloped off towards the base, while the latter is smooth and even, being filled up by small pointed scarlet granulations, not painful or readily bleeding. At the margin there is an outer opaque zone and an inner transparent, where new skin is forming; the pus decreases and the wound becomes dry, liquor puris alone exuding. Pain is absent (healthy ulcer).

Healing by Granulation.—As soon as the inflammation is reduced within proper limits, lymph, as before stated, is effused into the sides and base of the ulcer. This lymph becomes the seat of development of numerous small vascular branches, due to projection from the nearest old vessels; these coalesce to form loops, which again give off fresh shoots, forming new loops. Granulations are composed of leucocytes connected by a sparse homogeneous intercellular substance surrounding these loops. The cells nearest the edges become converted into new cuticle; those covering the surface are shed as pus; the deeper ones become converted into fibrous tissue. Directly the surface of an ulcer is studded with healthy granulations, the edges and base having reached a uniform level, the granulations nearest the edge cease to secrete pus, and are glazed over by a thin, almost transparent covering of new skin formed by segmentation of the epithelial cells at the margin; inside this is a red circle, which in its turn becomes covered, and thus the process extends. As the sore heals over there is a movement of contraction owing to the conversion of the granulations into a low form of fibrous tissue, the leucocytes being developed into connective tissue corpuscles, and the intercellular substance fibrillating. This contraction proceeds long after the ulcer is cured, and accounts for the fact that a scar is always smaller than the raw surface it re-

places. If the ulcer be deep, destroying the cutis vera, there will be no hairs or sweat glands in the cicatrix; the latter is at first pink and very vascular, but gradually becomes whiter as contraction obliterates the vessels, and assimilates itself to the surrounding tissues. The scar grows with the body; for instance, a child having a scar equal to half the length of his finger, on reaching manhood the scar will occupy the same extent, but as a man's finger is much longer than a boy's, it is evident that, though relatively the same, the scar has really increased in length. The scar is always of a less vigorous vitality than the original tissues, and is apt under fresh irritation—as slight pressure, or a contusion, or from any morbid condition of the general system—to again assume a process of ulceration. The liability of cicatrices to become the seat of new growths, as epithelioma, should be remembered.

Number and Variety of Ulcers.—1. Healthy (*vide supra*).

2. Weak or oedematous. The granulations are large, swollen, bulbous, flabby, and pale; to the touch they feel soft and velvety. They are often raised above the level of the surrounding skin, and their vascularity and vitality is less than in the healthy kind. The edges are smooth and colourless, or of a purplish hue. The discharge is pale and thin.

3. Callous, indolent, or chronic is that form which is so frequently met with after middle age in men; it is usually situated about the shin or ankle on the outer or inner side of the leg. This ulcer is deep, with firm, hard, insensible, purplish, and irregular edges; the base flat, of a white, grey, or brownish colour, covered with ill-formed granulations, exuding a scanty, thin, and watery discharge. The surrounding tissues are matted together, congested, and pigmented, the skin being firmly fixed to the subjacent fascia. Though these ulcers often attain a large size, there is little or no pain present.

4. Irritable: is met with in nervous, anæmic women about the middle of life, and is situated about the ankle or shin. It is usually single, of no very great extent, superficial, and confined almost entirely to the true skin. Its edges are thin and jagged, not elevated, and of a dull red colour. Base is covered with

a dirty grey slough, or reddish brown granulations. The great characteristic is the excessive, almost agonizing pain, quite disproportionate to the apparent symptoms, and a consequence of compression of the nerves in the margin and base of the ulcer: on passing a probe over the surface of the sore, one point will often be found exquisitely sensitive; here the nerve fibre is exposed.

5. Inflamed: is often situated at the lower half of the leg. The adjacent skin is red, dusky, hot, tender, swollen, and eczematous. Base only slightly depressed, granulations greyish. Edges ragged and thready, or cleanly cut and abrupt. Discharge offensive and bloody: in severer forms this becomes the—

6. Phagedenic or sloughing variety, the ulceration rapidly extending, accompanied by severe pain from exposure of nerves, and great débris of tissue. Constitutional disturbance is severe.

7. Hæmorrhagic: is when at a catamenial period in women suffering from amenorrhœa; the surface of an ulcer is the seat of a discharge of blood. These ulcers are usually of the irritable type, presenting a blue, congested appearance. In scurvy and the hæmorrhagic diathesis ulcers will also bleed profusely.

8. Varicose ulcer depends on a varicose condition of the saphenous veins, their valves being deficient. The skin becomes congested, dusky, and blue, as a result of thrombosis of the capillaries; then the vitality of this small piece of skin being lowered, it gives way, and a cavity is formed. Patches of discoloured skin, varying in colour from purplish black to grey, are frequently seen in proximity to this ulcer; these are dependent upon deposit of pigment. A source of anxiety is the liability, if one of the veins is implicated, to copious hæmorrhage. It is to be remembered that simple and varicose ulcers are generally single, and occupy the inner surface of the limb just above the ankle. This will aid in their diagnosis from syphilitic ulcers, which are commonly situated on the outer side of the leg, and are multiple.

9. Specific, depending on special causes, as tubercular, syphilitic, strumous, diphtheritic, cancerous, lupoid, etc. Old chronic ulcers, as a rare event, may assume an epitheliomatous action, and become converted into carcinomata.

Treatment.—Rest in bed is of the utmost importance in aiding local treatment in all forms of ulcers. In the healthy variety water dressing is often sufficient, with the addition of a weak antiseptic, as boracic acid, acetate of lead, carbolic acid (1 in 400); or oil dressings, together with a carefully applied bandage. Pirrie writes: "Ulcers should be cleansed by being very gently sluiced with water, simple or medicated, as the sore may require; and this can be most conveniently done by means of a Higginson's syringe. Ulcers should never be sponged, and if, in any case, a sore must be wiped, it must be done by means of lint or charpie, or cotton, which should be burned as soon as used." Esmarch's irrigator is a useful appliance for cleansing the surface of an ulcer. If the granulations assume a weak type, red wash (sulphate of zinc, tr. of lavender, and water), weak solutions of iodine, nitrate of silver, sulphate of copper, or solution of chloral (gr. xij to ʒj) are of service. Dry lint, absorbent cotton, marine lint, or a piece of sheet lead, with pressure by bandaging, will have a good effect. The transplantation of cuticle is very advantageous; the best time to transplant is when the granulations are healthy, and have been established four or five days; the piece of skin should be shaved off as thin as possible, as it melts away until the Malpighian layer is in juxtaposition to the granulations. The person the skin is taken from should be young, if possible, as then the process is more certain: the piece of skin need not be much larger than the head of a pin. The reason that transplantation is of service is that epidermis is more readily developed from epidermis than from granulation tissue, which takes its origin from connective tissue. In large ulcers several grafts should be planted not more than half an inch away from healthy skin; they should be covered with isinglass plaster, and not disturbed for three days. When this process is used the scar is more flexible and less disposed to contract.

Sponge grafting is recommended by Hamilton. A fine section of sponge is applied to the granulations, covered with oil silk, and a piece of oiled lint, with a pad of absorbent cotton bound over this. The sponge is first soaked in a solution of nitro-muriatic acid, and then washed in a solution of ammonia or potash; before

being applied it is steeped in a 5 per cent. solution of carbolic acid.

The callous variety is treated by stimulant methods, as rubbing nitrate of silver over its surface, then applying a poultice, and finally strapping the limb and bandaging it firmly. A pad of absorbent cotton placed over the ulcer, and outside this a starch or plaster of Paris bandage, is an effective plan. Martin's rubber bandage is serviceable. Syme's method is excellent, and consists in applying a blister slightly larger than the ulcer, or if this be very large, painting the edges with blistering fluid. If the skin be adherent to the subjacent tissues, several liberating incisions round the ulcer are useful. To soften the hard edges, prolonged immersion in a warm-water bath should be tried. As local applications, black wash (calomel and lime water), yellow wash (hyd. perchlor. and aqua calcis), sp. terebinth., iodine, chloral hydrate, zinc ointment, creasote and resin ointment, camphor and juniper oils, turpentine and resin ointments, are all of use. Iodoform is of great service in cleaning a dirty-looking ulcer. In obstinate cases free removal of granulating surfaces, with Volkmann's spoon, followed by the application of the actual cautery.

For irritable ulcers the employment of nitrate of silver deadens the pain, and then lead and opium lotions. To relieve the pain, Hilton's method of subcutaneous division of affected nerve is good. Internally, iron and quinine. When the ulcer is inflamed, two or three leeches round the sore, cotton wool dipped in tr. opii, and spirit lotions. Internally antimony and Dover's powder, or liq. ammon. acet. with opium. If sloughing, prolonged immersion in water as hot as can be borne; the following application applied once—

℞ Bromin ʒj,
Pot. brom. gr. xxx,
Aq. ad. ʒij—

is effectual, followed by iodoform, chloral, yeast, or charcoal poultices, warm opiate and soothing lotions.

If hæmorrhage be present, the elevated position, rest, pressure, and astringents, as gallic acid, tannin, matico, perchloride of iron. Attention to the menstrual function, and giving preparations of iron, aloes, ergot, tr. hamamelis, etc.

For varicose ulcers, rest, elevated position of limb, and a bandage from the toes to the groin, to relieve the pressure of the column of blood; locally black wash, tannic acid, tartrate of iron, and iodoform are serviceable. Martin's rubber bandage applied before the patient rises in the morning, the skin having been well powdered, and taken off at night and washed, is very useful if the patient cannot rest in bed, and to prevent the cicatrix reopening. The rubber bandage, however, must not be used if eczema be present. When the ulcer has cicatrised an elastic stocking may be worn, or the veins may be obliterated. Curved incisions, free and deep, may be made on each side of the margin of the ulcer, as recommended by Gay.

In all cases of ulcer the state of health of the patient must be carefully enquired into; tonics and cod liver oil being given in the enfeebled, and a strict diet with purgatives in the plethoric. Donovan's solution of arsenic and tinc. opii (℞xv) given three times a day, seems to aid the healing process when the granulations are deficient in tone. Hypodermic injection of a solution of pilocarpine will help recovery in obstinate cases. In specific ulcers the different conditions of health must be carefully considered in the treatment, or failure will inevitably result.

It is worth remembering that a change of treatment, both local and constitutional, is often most desirable and effectual in chronic ulcers.

CHAPTER IV.

GANGRENE :—DRY, MOIST, SENILE, TRAUMATIC.

GANGRENE, or mortification, is that process which causes the death of a tissue in mass; the dead tissue being termed a sphacelus or slough: when the disease occurs in connection with bone it is called necrosis, and the dead bone a sequestrum.

Causes.—(α) Any disturbance of the vascular system. (β) Defective innervation of the part. (γ) Mechanical and chemical agencies. (δ) Certain poisons.

(α) 1. Obstruction in the arteries by ligature, compression, rupture, wound, thrombosis, embolism, and disease of the arterial coats resulting in occlusion; the collateral circulation being insufficient to maintain the vitality of the part.

2. Obstruction in the capillaries from strangulation by the pressure of inflammatory products, hæmorrhage, new growths, etc.

3. Obstruction in the veins, though unless this be accompanied with some obstacle to the arterial circulation, it is seldom alone sufficient to give rise to gangrene, *e.g.*, if both the main artery and vein of a limb are wounded or compressed.

4. Diminished cardiac action, generally associated with some other cause.

5. Inflammation acts by causing stagnation of the blood, degeneration of tissue, compression and stretching of the capillaries, and thus interferes with the circulation.

(β) Defective innervation of the part arises from division or injury of some nerve trunk, as exemplified in sloughing of the cornea occurring after injury to the fifth nerve, or bed sores following damage to the spinal cord.

(γ) Mechanical violence and chemical agencies ensue from severe contusion or laceration, excessive heat or cold, and corrosive substances which destroy the tissues; some amount of inflammation usually precedes gangrene from this class of causes. Gangrene, produced by extravasation of urine or fæces, is included in this division.

(δ) Poisons introduced into the circulation, either chemical, as ergot of rye, mercury, and phosphorus, to which

should be added diabetic sugar; or specific, due to inoculation of the tissues with micro-organisms, as in hospital gangrene, acute traumatic gangrene (*gangrène foudroyante*), cancrum oris, noma pudendi, malignant pustule, carbuncle, and certain cases of boils.

Dry Gangrene is consecutive to obstruction in the arterial circulation. The place affected assumes a pale, tallowy-white appearance; here and there mottled grey or brown. There is loss of motion and sensation, whilst if the part is exposed it loses its natural temperature, becoming cold: in the area involved the arteries cease to pulsate. As the disease progresses the pain becomes very severe, and the skin is converted into a black, wrinkled mass, and increased in hardness (mummification.)

Moist Gangrene.—In the first, or congestive stage, there is numbness, succeeded by intense burning pain due to the nerve trunks being implicated; the pain continues until separation begins; the temperature and sensibility of the part are exalted. Swelling occurs, at first hard and then soft and œdematous. Colour at the beginning is red, but soon becomes purplish or black. The cuticle separates, forming vesicles which contain transuded serum.

The second stage, or that of complete stasis, is thus indicated. The part becomes cold, even of a lower temperature than the surrounding atmosphere, as the result of evaporation; all power of motion and sensation is lost, and the seat of the disease is deprived of its firmness and elasticity, becoming soft, doughy, and pitting on pressure. The skin acquires a greenish yellow hue, with dark mottled spots or lines over its surface, as a consequence of the breaking up of the blood corpuscles and the escape of the colouring matter from the blood. The colour gradually deepens into a reddish brown or greenish black, as the iron of the blood corpuscles combines with the sulphur of the tissues, and a putrescent odour is exhaled.

Third stage, or decomposition, now proceeds, various gases, as ammonia,

sulphuretted hydrogen, etc., being generated in the part, producing emphysematous crackling of the tissues, and emitting an offensive stench.

Moist gangrene is more rapid than dry, and more intense and dangerous, tending to spread rapidly (diffuse), and giving rise to more severe constitutional disturbance.

Constitutional symptoms of gangrene assume a low type of fever. The patient is extremely prostrated, weak, and exhausted; the countenance is pale, cold, moist, with anxious, wild, apprehensive look, and contracted features. The pulse is feeble, very quick, intermittent, and small. The tongue is brown, rough, dry, and the legs covered with sordes. Skin at first hot and dry, subsequently bathed in cold, clammy sweat. There is incessant hiccough, and often coffee-coloured vomiting; the appetite is lost. The breath has a peculiar characteristic smell; urine is scanty, and may be suppressed; putrid diarrhoea is not uncommon. Delirium, of a low, muttering character, succeeds, followed in unfavourable cases by twitchings, coma, and death.

Consequences.—The process of gangrene may extend without any attempt at repair (diffuse gangrene), or after involving more or less tissue become arrested, a line of demarcation forming, and the slough being cast off (circumscribed gangrene). This latter result takes place in the following manner: The living tissue, adjacent to the slough, is irritated by the dead part acting as a foreign body. Inflammation ensues, isolating the sphacelus by a layer of lymph, similar to that occurring round collections of pus. The skin assumes a reddish blush, fading off into healthy tissue (line of demarcation), whilst the living part, next to the slough, becomes full of white corpuscles, by degrees taking on a more and more liquefied state, due to a process of ulceration, combined with suppuration. When the dead part is completely separated by this means it is cast off in a mass. The process of separation takes place at a higher level in the skin than in the subjacent tissues of a limb, thus forming a conical stump. The cavity which remains is covered with granulations, and healing proceeds by that process. If the dead portion be deeply seated the gangrene progresses outwards to the surface, as seen in necrosis of bone. Another termination, if the process be less intense, is that the

dead part may become enveloped by a capsule of connective tissue (encapsuled), when it is rendered inert, often being absorbed or dried up, or in some cases becoming calcified.

Treatment.—Local. Remove the cause, if possible. When gangrene is threatening, relieve local tension by sufficiently free incisions, two to three inches in length. Maintain the heat of the part by cotton wool, flannel bandages, and hot-water bottles, placed closed to but not touching the site affected. Raise the limb slightly in dry gangrene, and more in moist, to promote the venous circulation. The gangrenous parts should be covered with lint, soaked in solution of carbolic acid, creasote, chloride of lime, or acetate of alumina (alum 3v, plumbi aceticum 3j to aq. Oj), or dusted over with pulverised charcoal. If the slough be of moderate extent poultices of yeast or charcoal are good. Assist nature to separate the parts when quite dead by the scissors, pliers, or saw. Should hæmorrhage occur,—though this is usually prevented by the occlusion of the vessels with lymph,—pressure, the actual cautery, the ligature of the artery higher up, or as a last resort amputation is required. The line of demarcation should be kept clean, and dressed with some mild stimulant, as oil of turpentine one part, olive oil six parts; or chloride of aluminum one part, olive oil twenty parts; or camphor and juniper oils. If the sloughs do not readily separate, balsam of Peru, or nitric acid and opiate lotions are useful. The granulating surface which is left must be treated as an ordinary ulcer.

Constitutional.—For the relief of the pain, opium (gr. j 6th hor.) is better than morphia or any other sedative. The annoying hiccough can be stopped by camphor and ether. To commence with, mild antifebrile remedies are useful. but as the disease advances stimulants must be given in large quantities—wine, especially champagne, brandy, porter, together with ammonia, camphor, ether, chloroform, etc. Vegetable tonics, as gentian, cinchona, cascarrilla, nux vomica, etc., are of service. The disease is always very lowering, therefore the patient's strength must be kept up by giving him the most nutritious diet, peptonised milk being a good form to administer as nutriment, with strong beef tea, etc. As the slough is loosened, cod-liver oil,

iron and mineral acids are useful, conjoined with the greatest cleanliness, free ventilation, and the liberal use of antiseptics.

Senile Gangrene is that form which affects the lower extremities of old people. The causes which occasion it are an atheromatous or calcareous change in the arteries, together with degeneration of the muscular fibres of the heart. In several cases of senile gangrene I have noticed a precedent varicose condition of the veins. In some cases these causes are sufficient to produce the disease; in others the starting point is a slight abrasion, injury to a corn or toenail, or excess of heat or cold. Any such slight injury is sufficient to set up inflammation in a part already weakened, and result in its death.

Symptoms.—*Premonitory.* Abnormal sensations in the limb, as a sense of weight, coldness and tingling of the feet, cramps in the calves, whilst the circulation is weak or may be absent in the tibials. Pirrie writes: "There is a premonitory symptom which causes great alarm in my mind, as I have known many cases where it was complained of for a length of time before the occurrence of senile gangrene, namely, the feet becoming perfectly cold, and almost insensible, on walking to an extent to increase in any degree the general circulation."—*Local.* It commences as a blackish spot on the inner side of the great toe, or the extremity of one of the smaller toes. This spot is surrounded by an inflamed circle to which the disease spreads, and the cuticle becomes detached. Gradually the gangrene creeps up the limb, and unless a line of demarcation form it will advance until the death of the patient occurs. The pain is severe, and the type of disease is dry gangrene. The constitution is profoundly affected.

Treatment.—A light nourishing diet, with a moderate amount of stimulants, is necessary. The bowels must be kept open by a saline aperient and vegetable tonics with ammonia administered. Opium is of cardinal importance, given in half-grain doses every four hours. Brodie writes, "If I am not greatly mistaken, the results of a particular case will very much depend on this, whether opium does or does not agree with the patient." Pulv. ipecac. co. is often a good form to prescribe.—*Local.* Cotton

wool wrapped round the limb, covered with a wollen stocking to maintain the temperature, and lint soaked in an antiseptic to the dead part. The after treatment is similar to the other varieties of gangrene.

Traumatic Gangrene may be local or diffuse. The local form is of the moist variety, and is limited, without any tendency to spread. The diffuse may occur: 1. From obstruction in the vein, together with diminished cardiac power. The exciting cause is some injury, but the gangrene commences on the second or third day afterwards, at the extremity of the limb and not at the seat of the wound. The disease spreads most rapidly, is of the moist form, and accompanied by great depression. 2. From specific infection, due to inoculation of the tissues at the seat of the wound by the products of decomposition associated with the presence of micro-organisms. This variety commences at the wound, and spreads towards the trunk. It begins before suppuration is established, and is most common in persons of broken-down constitutions, particularly those the subject of kidney disease or chronic alcoholism.

Amputation in Gangrene.—In local traumatic gangrene amputate through sound tissue as near injured place as possible, without waiting for the possibility of a line of demarcation forming. In diffuse septic traumatic gangrene amputate the limb at a distance from the point affected, in the upper extremity at the shoulder, in the lower at the upper part of the thigh, as soon as the disease is diagnosed—strict aseptic precautions should be observed.

In gangrene following burns or frost-bite, it is desirable to await the line of demarcation, and amputate close above it. In gangrene arising from constitutional causes, the rule is to stay for a line of separation before amputating. In senile gangrene, amputation through the thigh is an admissible operation in suitable cases. It is to be remarked that in this form, when toes are attacked, there is often a period when the gangrenous process appears to have stopped before proceeding to affect the other part of the foot. Here a Syme's operation is frequently effective. Should this period be missed, again a stoppage is made at the ankle, when amputation through the lower third of the thigh is justifiable.

CHAPTER V.

THROMBOSIS—EMBOLISM—PYÆMIA—SEPTICÆMIA.

A **THROMBUS** is a coagulum found in the interior of an artery, capillary, or vein, and obstructing to a greater or less degree the lumen of the vessel. Thrombi may be divided into primary, which are formed at the seat of disease or injury; and secondary, occurring later, from the prolongation of a primary one along the vessel, or formed round an embolus or foreign body. The blood, whilst circulating, is naturally unwilling to coagulate; thus this process never occurs in healthy vessels, some injury or disease of the vessel or heart being a necessary precursor. Coagulation is due to the union of fibrinogen (contained in blood serum) with paraglobulin (present in serum and white corpuscles), in the presence of fibrin ferment (met with in white corpuscles).

Causes may be classed under: 1. Those leading to a slackening or stoppage of the blood stream; 2. Changes in the vessels or blood.

1. (a) Diminished cardiac power, as in chronic wasting diseases, *e.g.* phthisis; here the coagulation occurs in the veins, commencing behind the valves.

(β) Solution of the continuity of a vessel. In this case the formation of a thrombus is necessary for the cessation of hæmorrhage (*vide* chap. xviii.).

(γ) Increased intravascular resistance from diminution of the calibre of a vessel, as seen in ligature, pressure of tumours, or inflammatory exudation, etc.

(δ) Dilatation of the heart or vessels, as in aneurism, varicose veins, etc.

2. (a) Changes in the vessels are usually caused by inflammation, arteritis or phlebitis. Other causes are atheroma, calcareous degeneration, spicula of bone or other foreign bodies, together with new growths protruding into the lumen of the vessel.

(β) Changes in the blood, an increased tendency to coagulate, due either to an excess of fibrin-forming materials, as in acute inflammatory diseases and pregnancy; or to alteration in composition from defective elimination, as in gout;

or the introduction of infective matter, as in septicæmia.

Formation.—When, from any of the preceding causes, the blood coagulates, if the latter be in rapid motion, and the focus of coagulation small, the thrombus is composed of white corpuscles only and fibrin, and is of a grey colour (white thrombus); if the blood stream has quite ceased the clot is of a dark red colour and jelly-like consistence (red thrombus); but as time goes on it becomes whiter, drier, more fibrinous, less elastic, and firmly adherent to the coats of the vessel. A third variety is called the mixed, the white being mingled with some red corpuscles. When once thrombosis has commenced it generally progresses until the vessel is closed, and extends in the course of the branch until it reaches the nearest collateral twig, where its further advance is stayed by the strong current of blood. The end of the thrombus next the heart is smooth, rounded, and conical in shape.

Changes.—When formed, the clot either becomes—1. Absorbed; 2. Organised; 3. Softened; 4. Suppurates; 5. Calcifies.

1. Absorption may take place either from the centre or from the circumference.

2. Organisation of a clot is considered in chap. xviii.

3. Softening occurs in all septic thrombi and in large simple clots. It begins in the centre of the coagulum, and by degrees spreads outwards. The clot breaks down into a soft, pulpy material, consisting of albumen, fatty matter, and altered red and white corpuscles; as the disintegration proceeds the blood current washes the minute particles away.

4. Suppuration is rare. The leucocytes emigrate from vasa-vasorum and adjacent blood-stream, the endothelium of the vessel probably participates, and the leucocytes in the clot may proliferate.

5. Calcification occurs in veins forming phleboliths, or vein stones, composed of proteid matters, phosphate of lime,

and a small quantity of sulphates of lime and potash.

Results.—1. The destruction of the clot by the process of softening often sets up acute inflammatory changes in the vessels, particularly the veins. 2. Circulatory obstruction is produced by the presence of a thrombus, and if a vein be the seat, should the collateral circulation be insufficient, the part becomes œdematous, tense, painful, swollen, and of a tallowy whiteness. The vein is hard, knotted, and painful, whilst the lymphatics are obstructed and inflamed, appearing as red streaks. Diffuse cellulitis may also occur. As the circulation is restored, this condition, as a rule, disappears, but occasionally the part remains enlarged, hard, and brawny. When an artery is occluded, if the collateral circulation be speedily established, the vitality is preserved; if not, gangrene ensues.

Embolism is the arrest of emboli,—or solid matters entangled in the blood, and having their origin at some distant part of the circulation,—in some of the small vessels or capillaries. Emboli may consist of various substances, such as portions of broken-down thrombi, generally venous, vegetations, calcareous and atheromatous masses, fat set free by the laceration of adipose tissue, as from the medulla of bone as a result of fracture, foreign bodies, entozoa, and other substances. The foreign particle, whatever its nature, is carried by the blood stream until it reaches some vessel which is too small to permit its passage. Emboli originating in veins or the right side of the heart, are stopped by the pulmonary capillaries; in the portal system by the hepatic capillaries; in the systemic arterial system by the capillaries of the brain, kidney, spleen, etc. The embolus may partially or wholly occlude the vessel; in either case a thrombus is formed before and behind, up to the nearest collateral branch, and this thrombus behaves exactly as a thrombus formed by any other exciting cause.

Changes.—1. If the coagulum be healthy only local trouble ensues, namely, thrombosis, extending backwards and forwards to the next collateral branch, followed by an endarteritis: the clot is then absorbed or organised, and only a little inflammatory induration remains,

but in some cases the vessel is occluded.

2. If the clot has septic properties it causes a periarteritis and suppuration, and so occasions metastatic abscesses. In addition to these local results, if a vessel of an important organ is affected the blood supply is diminished or stopped, and the functions of the organ disturbed; as in the brain, causing apoplexy; in the lungs, producing asphyxia; in the heart, syncope. If the vessel be a terminal one, and the parts supplied by it be thus unable to procure blood through collateral branches, the local anæmia passes into necrosis, with suppuration or degeneration. Should there be a collateral circulation, the blood by this means will find its way into the affected area, thrombosis occurring in the blocked-up branch; or else, if the blood supply be too small for this to take place, the portion of tissue will become the seat of hyperæmia, from enlargement of the capillaries and regurgitation from the veins, the blood being unable, from deficient propulsive power, to force its way through the part. In this manner is produced congestion, diapedesis, etc., until the whole area becomes a firm, dark red, granular mass (Hæmorrhagic Infarct). Hæmorrhagic infarcts are frequently seen in the lungs, spleen, and kidneys. They are reddish, firm masses of a wedge shape, with the apex towards the centre of the organ. They may be enclosed by a wall of inflammatory new tissue, the wedge finally becoming vascularised and developed into connective tissue, forming a cicatrix, but if the result of septic emboli they always terminate in suppuration, forming a metastatic abscess.

Pyæmia is a disease due to the circulation of some animal poison in the blood, and characterised by severe and peculiar constitutional disturbance, followed by well marked local lesions.

Causes.—Predisposing. Overcrowding, want of proper ventilation, defects in quality or quantity of the food, mental depression, previous illness, exhaustion from chronic disease.—Exciting. Wounds, especially if contused or lacerated, injuries, or inflammation. It is very apt to occur if pus be deep-seated or confined. One form is common after child-birth. Wounds of veins, bones, or joints, are particularly liable to be followed by this disease.

Symptoms rarely begin before the eighth to the twelfth day after an injury. There is a severe rigor preceded by a great rise in the temperature, 105° F. to 107° F. The rigor is followed by tremendous sweating and a considerable fall in the temperature, even below the normal, but it at once begins to rise again. In from twenty-four to forty-eight hours a second rigor occurs, which is followed by others. The rigors are usually associated with a feeling of chilliness, and always with great prostration; in some cases the rigors may be absent, but there will be profuse perspirations and fluctuations in the temperature. If there be a wound it becomes dry, ceasing to discharge, the granulations are destroyed; thrombosis appears in the vicinity; and the adjacent lymphatics are enlarged; as an exceptional event the wound may continue healthy. The breath acquires a sweet odour, like new hay; the pulse is small and frequent; voice and respiration are weak, with often great dyspnoea. Offensive diarrhoea is not uncommon. The tongue is dry brown or blackish, and as the disease advances the teeth become covered with sordes, or a crop of herpes may break out on the lips and face. Fugitive livid erythema, purpuric patches, boils, vesicles, or pustules are frequent. The skin assumes a yellow colour; abdomen may be tympanitic. Rapid wasting follows, with great depression. About the sixth to the tenth day suppuration presents itself, and various abscesses form in the joints, muscles, connective tissue, and internal organs, particularly the lungs and the liver. Intense cutaneous tenderness accompanies this, the patient screaming out on being touched. The weakness increases; a state of delirium supervenes, alternating with coma; finally, the unhappy sufferer sinks from exhaustion about the tenth day. Sloughs and bed-sores are common, forming with startling rapidity. If the disease be prolonged over three weeks a recovery is possible. Pyæmia in some cases is more latent in its commencement, the rigors being slight or absent, and the disease being only recognisable by the secondary abscesses.

Metastatic abscesses are in most cases of embolic origin, the emboli arising from the venous thrombi formed at the

primary seat of inflammation. These coagula become infected with the specific poison causing the disease, are broken up, disintegrated, swept away by the blood stream, and wherever stopped, occasion suppuration and abscesses. In some cases the abscesses arise from thrombi forming spontaneously at a distance from the seat of infection, without the intervention of an embolus; this is doubtless due to alteration in blood, and general lowered nutrition of the vessel-walls and surrounding tissues.

The abscesses are met with in the viscera, as lungs, liver, spleen, kidney, and prostate; in joints, swelling rapidly making its appearance, at first white and tallowy, then soft and livid; in the subcutaneous, subfascial, and intermuscular connective tissue planes. The most common visceral seat is the lung at its posterior part, this being often studded with these abscesses surrounded by an inflammatory zone: the next most liable organ is the liver. In some cases the abscesses are preceded by hæmorrhagic infarcts, but often suppuration arises without there being any previous infarction. In the liver and subcutaneous tissues infarction is never present. Of the joints, the knee, elbow, and shoulder, are most often found filled with pus, the formation of which is attended with very acute pain, fluctuation, and swelling. The intermuscular connective tissue of the axilla, gluteal region, back, iliac fossa, thigh, and calf, are the favourite seats of purulent collections. Of the serous membranes, the pleura, pericardium, peritoneum, and arachnoid are most commonly affected. The most characteristic feature of these abscesses is the rapid way in which the tissues melt away without the slightest attempt at repair.

Diagnosis.—The only disease liable to be confounded with it is ague. In this latter complaint the rigors are periodic, and the fever disappears between the attacks. The suppurative changes are pathognomonic of pyæmia.

Prognosis is exceedingly unfavourable, most persons attacked rapidly dying.

Bad signs are a high temperature between the rigors, quick succession and severity of these, and the implication of an important organ. Favourable symptoms are lowering of the temperature, only one joint being affected,

cessation or absence of rigors, healthy appearance of the wound.

Nature of Pyæmic Poison.—All that is known of this is that in its development it is always joined with the septic decomposition of inflammatory materials, and that the fluid containing it swarms with micro-organisms, rod-shaped vibratory bacilli and round micrococci.

Treatment.—The prophylactic treatment consists in avoiding overcrowding, scrupulous attention to cleanliness, and free ventilation. The patient should be brought into as favourable a state of health as possible previous to an operation. Give free exit to pus, efficient drainage, and keep wound aseptic, carefully washing out all pockets where matter might collect. If pyæmia be prevalent, postpone all except life-saving operations. The curative treatment is unfortunately eminently unsatisfactory, but still patients occasionally recover. Perseverance and attention to every small detail should be the surgeon's motto. Maintain the strength of the patient by nutritious diet, as peptonised milk, beef tea, new laid eggs, etc., and the liberal use of stimulants, as champagne or brandy, administered at frequent intervals *by night as well as day*. Effervescing salines containing excess of ammonia and iron. Quinine in large doses (gr. xx to xl in the course of the day), or salicylate of soda (gr. lx to lxx in a day). Warburg's tincture and antipyrin, ice packs, are all useful in lowering the temperature. Keep the bed and room cool, and sponge the surface of the body with vinegar and water. Other remedies which are often useful are: Ext. opii liq. m.v. om. hor. ; oil of turpentine in 3ss doses; mineral acids. All abscesses must be opened as soon as diagnosed, and the cavities syringed out with some aseptic fluid, as corrosive sublimate solution (1 in 1000). The patient is not out of danger until quite well, relapses being common; even should he recover, death may subsequently ensue at a more or less remote period from malnutrition or disease of the lungs or kidneys.

Septicæmia is blood poisoning, due to absorption of chemical products resulting from the septic decomposition of inflammatory materials, but unaccompanied by secondary foci of inflammation or by

metastatic abscesses. The poison is in some cases associated with the presence of micro-organisms, and is then capable of multiplication within the body and inoculation, in others it is due to ptomaines or alkaloids derived from decomposition of animal substances. Some authorities term this latter condition sapræmia.

Causes.—Inoculation with putrid matter, as in making post-mortems, or the use of dirty instruments, absorption taking place through a wound already existing or made at the time of inoculation. Cases are met with without an open wound, the poison having found its way into the body through the respiratory tract or some other way.

Symptoms much resemble typhoid fever. There is a period of incubation, the duration of which is uncertain, but probably this is never very prolonged. There may be a rigor, but usually there is none. The patient feels very ill; the temperature varies, rarely rising above 104° Fahr., and there are no distinct remissions. Exceptionally the temperature may be subnormal. Nervous symptoms are always present, commencing with headache, passing on into low muttering delirium, and terminating in coma; the patient is drowsy and apathetic. Pulse is feeble, easily compressed, intermitting, jerky, and very rapid. Tongue is parched and dry, often brown; sickness and vomiting may be troublesome. Respirations are weak and hurried. At first there may be great sweating, afterwards the skin is dry, and often presents a tawny colour, jaundice also may be present. There is either constipation or diarrhœa with bloody stools. Urine is scanty, high coloured, and may contain albumen; it is thought the poison is eliminated by the kidneys. Bed sores are common. Swelling of the spleen is constantly present. Thrombosis and extravasations in the organs and cellular tissue sometimes occur.

Complications.—Pneumonia, bronchitis, skin eruptions and inflammatory affections of the serous membranes.

Prognosis.—The pulse and tongue are more important than the temperature. A small rapid pulse and a dry tongue are bad omens. Very high or low temperatures are dangerous. The prognosis is always serious.

Treatment.—Local. Wash wound with

perchloride of mercury solution (1 in 1000) or chloride of zinc (gr. xl to ʒj), then medicated poultices and local baths. Constitutional remedies are similar to those used in pyæmia. Tr. digitalis is also of service. Ice to check vomiting. It is to be remarked that in nearly all these

cases, if you can assist the patient over the critical period of the first few days, the poison will be eliminated, and recovery ensue. About half the cases die. I cannot too much insist that if it be possible a trained nurse should always attend the patient.

SECTION II.

SPECIAL INFLAMMATIONS.

CHAPTER VI.

HOSPITAL GANGRENE—BOILS—CARBUNCLE—WHITLOW.

Hospital Gangrene or Sloughing Phagedæna is produced by a specific poison; it is one of the greatest scourges in military hospitals, but in civil practice is rarely met with.

Causes.—Predisposing. Overcrowding, want of cleanliness, deficient ventilation, moist or damp atmosphere and a neglect of hygienic principles.—Exciting. A special organism, of which the exact nature is unknown, but possessing the power to effect the death of granulations and adjacent tissues. The tenacity with which the materies morbi clings to dressings, instruments, etc., is remarkable. When once started, the disease may spread by contagion; though it is not infectious.

Symptoms.—Local. The wound becomes covered with a yellowish grey slough, and rapidly extends both in depth and width. The surrounding structures are of a dark red colour, infiltrated, and cedematous. The edges of the wound come to be inverted and well defined; there is a yellowish brown discharge stained with blood, and the slough sticks tenaciously, resisting attempts to remove it. The pain is very severe, of a gnawing, burning character, and there is much fœtor. This variety is termed the Pulp Form. Glandular swellings are often present in the groin or axilla; several glands are generally involved, accompanied with pain and tenderness; they may suppurate, and the resulting sores resemble the exciting one. The disease progresses rapidly, especially along the

connective tissue planes, the muscles are laid bare, and in fine even these may be implicated, and the subjacent bones exposed. As the sloughs separate, a large granulating surface is left; whilst this process is happening, profuse hæmorrhage from some of the arteries yielding is often seen; this is most likely to occur about the eleventh day. Another form, designated Ulcerative, is marked by the formation of a vesicle at a little distance from the edge of the wound, this becoming a pustule, ulcerating, and breaking into the original wound.

Constitutional symptoms are not so severe as the local effects would lead one to expect. At first they are those of the sthenic type of fever, gradually changing as the disease progresses into the asthenic or irritative form. Delirium often sets in early.

Treatment.—Remove the patient from the infected place—Locally, the patient being anæsthetised, the adherent slough is scraped off, and the bleeding stayed by the application of hot or cold water, then apply bromine or strong nitric acid, until it has soaked in beyond the diseased skin, the following prescription being a good one:—

R Bromin. f ʒj
Pot. brom. ʒij
Aq. destill. ad. ʒiv. As a lotion
(Goldsmith),

or permanganate of potash (ʒj to fʒj), or ol. terebinth. or acid nitrate of mercury, to thoroughly destroy all the diseased part. The wound may afterwards be

dressed with catechu and opium lotions, or charcoal or iodoform poultices. Use absorbent cotton instead of sponges, and burn it immediately after use. To stop arterial hæmorrhage, ligature the bleeding vessel, and if a ligature will not hold, liq. ferri. perchlor. with pressure, or the actual cautery. Should the bleeding still continue, amputation at a distance from the wound, under the strictest aseptic precautions, is the only resource.

Constitutional.—Keep the bowels well open with calomel and rhubarb, or equal parts of pil. hydrarg., jalap., and ext. colocynth. A very nourishing diet with medicinal stimulants. Quinine gr. v to x every four hours is useful. Opium gr. ij to v every six hours with ipecacuanha, or vin. antimon., ol. terebinth. mx every third hour is recommended. Change of air during convalescence is of the utmost service.

Boils v. Furunculi, are inflammatory lesions, partly local and partly general, the origin no doubt being in most cases some change in the blood, but occasionally the result of local conditions only.

Causes.—General. Unhygienic conditions, as vitiated atmosphere, a plethoric or exhausted state of the constitution, sudden changes of diet or mode of life, diabetes, renal disease, rheumatism, exposure to wet and cold, over-fatigue, unwholesome meat. In some cases they appear to be epidemic. As a sequence of febrile disorders, boils are not uncommon. Marked acidity or alkalinity of the urine are states often met with in this complaint. A form of boils is certainly of septic origin, either due to poisoning by some of the chemical products of decomposition (ptomaines), or to an active, rapidly growing virus dependent on the presence of micro-organisms; this variety sometimes occurs in surgeons, following autopsies. The mode of infection is generally through a punctured wound, but may follow the introduction of the poison into a hair follicle or sebaceous gland. Absorption occurs by entry into the connective tissue space, where it will be absorbed by the lymphatics in the ordinary manner; and more rarely by direct entrance into a lymphatic or vein.—**Local.** Any irritant disease, as scabies.

It is worth notice that now and then a crop of boils will follow the application of a linseed poultice, especially if the skin be not previously oiled.

Symptoms.—A painful, rounded, circumscribed tumour, involving the skin and subjacent connective tissue; of a scarlet, or violet red colour, with a hard and inflamed base. When a boil is forming there is pain and tension, then the reddish swelling appears; this enlarges, and suppuration occurs. The central part dies, and sloughs out, constituting the core. The most common seat is the back, neck, perineum, thighs, and limbs. In some cases boils are clearly due to inflammation of a hair follicle or sebaceous gland (follicular). In the septic varieties a pustule forms, followed by the development of a core; the disease is apt to appear in great numbers, often at intervals of weeks; considerable pyrexia generally co-exists. The cavity left after the slough is cast off heals by granulation.

Treatment.—The constitutional is very important. If the patient be plethoric, he must be carefully dieted, and a mild purgative course is useful, as rhubarb and tartrate of potash. If urine be acid, administer alkalies. When the patient is debilitated, tonics, as iron, nitro-muriatic acid, nux vomica, cod-liver oil, together with good food, port wine or Burgundy, and change of air. Yeast in doses of a tablespoonful three times a day is often of service. Sulphide of calcium in small doses, as recommended by Ringer, will hasten the maturation of a boil.—**Local.** Glycerine of belladonna will often relieve the pain, or warm lead and opium lotions. Spirit lotions applied warm are often of service. Collodion painted over an incipient boil will often arrest it. If the boil begins as a papule developing into a pustule, lin. iodid., nitrate of silver, or acid nitrate of mercury, painted in a wide zone round it, will occasionally keep it back. In septic cases, hot antiseptic fomentations with incision into the centre of the boil.

Carbuncle v. Anthrax.

Causes.—A debilitated, depressed state of health, habitual malnutrition, chronic wasting diseases, Bright's disease, gout, diabetes, etc. Subsequent to any of the zymotic diseases. Eating diseased meat.

Carbuncle is most commonly met with at and after the middle period of life. In some cases a poisoned punctured wound or hair follicle is the local cause, but as a rule there is none. There is good reason to believe that, in most cases, there is a special poison circulating in the blood.

Symptoms.—A carbuncle consists in a phlegmonous inflammation of the skin, with death of the cellular tissue beneath, and the formation of pulpy greyish sloughs. It commences as a vesicle, seated on a hard, broad, flat, purplish red base, which is perceptibly elevated above the level of the surrounding skin. It is always circular or oval, and remains throughout its course flat on the surface. The adjacent parts are brawny red, and hardened from fibrinous exudation into their substance, and the base enlarges by this area becoming implicated. As the local lesion increases in size, the skin passes into a darker colour, and finally gives way at several points, through which yellow or ash-coloured sloughs are discharged, and a scanty, thin purulent fluid. The sloughs are composed of connective tissue and fibrinous exudation; they never involve the muscles; abundant oil globules are met with. The pain is intense; of a burning, throbbing, or gnawing character. A large extent of tissue is often affected, varying from one to eight inches. The most usual situation is the back and the nape of the neck, though occasionally it is met with in the abdomen or extremities. A dangerous form occurs in children on the face.

Constitutional symptoms are asthenic from the first, and when the carbuncle is large, extensive sloughing and suppuration rapidly reduce the patient. Pyæmia, from the blocking of the adjacent veins, is now and then produced.

Diagnosis and Prognosis.—Carbuncle is distinguished from a boil by its wider extent, tendency to spread, greater size of slough, deep red colour of skin, its broad, flat surface, and the number of openings, together with its slower course. The prognosis depends upon the amount of surface affected, the situation—carbuncle of the scalp or face being very dangerous—and the presence of serious co-existing disease, as renal affections, or diabetes, which are very unfavourable. Pirrie points out two points of great importance, of both of which I have seen examples: he writes, "First, sometimes the symptoms of car-

buncle, even when far advanced, subside suddenly, and the patient dies in a few hours in a state of perfect collapse. Secondly, some patients, after months of perfect recovery from an immense carbuncle, are suddenly seized with violent pains in the stomach, and all the symptoms of shock, and die in five or six hours in dreadful agony.

Treatment.—Constitutional. A liberal diet, meat if the patient can take it, otherwise the strongest liquid diet. Opiates, except in Bright's disease, are indispensable. I have obtained the best results with digitalis and liq. ferr. perchlor. combined, the former in small doses, the latter in as large doses as can be borne. In the aged, carbonate of ammonia, with decoction of cinchona, is very useful. Quinine with the mineral acids, in some cases, is a serviceable remedy. Stimulants, as brandy, wine, etc., must often be given plentifully. Fresh air is of great importance, the room being thoroughly ventilated night and day.—Local. In the early stages the application of a wide zone of iodine liniment, acet. lyttæ, nitrate of silver, or potass. cum calce, repeated once or twice, will often stop its progress. This should be followed by equal parts of olive oil, turpentine, and tinct. opii applied on a piece of lint. Strapping in a concentric manner round the base of the carbuncle is also effective. If these means fail to delay its advance, there is nothing better than poultices of linseed, to which should be added, charcoal, yeast, or iodoform; it is necessary to oil the skin round the carbuncle to prevent its irritation by the poultices. In treating over a hundred cases, I have not found any other mode of treatment required, but if there be great pain, it is admissible to make free incisions subcutaneously through the substance of the carbuncle. Some surgeons divide the inflamed skin and subcutaneous tissues freely by crucial incisions; others recommend the application of caustic potash in substance to the centre of the swelling.

The cavity left when the slough separates appears very deep, but this is chiefly due to the thickened state of the surrounding tissues; the slough rarely extending beyond the deep fascia.

I have never seen any cicatricial deformity, the scars being unusually small compared with the size of the wound.

The best dressing to the granulating surface is balsam of Peru, or iodoform ointment. If incisions be made, it is recommended to brush permanganate of potash solution (3jss to 3j) over them.

Malignant Facial Carbuncle occurs in young persons from the inoculation of the lips with some animal poison. A pimple forms on the lips, and the swelling rapidly extends. The place affected is dusky, hard, and very painful. Vesicles or pustules form on the mucous membrane; the inflammation rapidly spreads upwards and downwards, towards the eye and the neck. Severe pyrexia, with rigors, is present. Thrombosis of the facial and external jugular veins occurs, and emboli may be carried to the brain or lungs. The deeper structures of the lips are full of minute abscesses.

Treatment is the same as for other varieties of carbuncle, but in this form incisions must be adopted; death generally follows within a week.

Whitlow v. Paronychia is a low form of inflammation affecting the finger.

Causes.—In some cases appears to be of an erysipelatous nature; in others, due to poisoned wounds. Occasionally it is epidemic. It is most commonly met with in debilitated and badly nourished individuals.

There are four varieties, depending upon which structure is implicated. 1. Cutaneous (*Paronychia ungualis*); 2. Cellulo-cutaneous; 3. Tendinous (*Paronychia tendinosa*); 4. Periosteal (*Paronychia osseosa*).

1. This most commonly occurs in children. The skin alone is affected; pus forms between the cutis and the epidermis, the skin being at first red, and then hot and throbbing. Over the seat of matter the skin is paler than normal, but round the abscess the surface is red. Slight swelling and pain accompanies the inflammatory process, but there is not much constitutional disturbance. Several fingers of one or both hands are frequently attacked, either simultaneously or successively. When the abscess bursts the whitlow soon heals.

Treatment.—A mercurial purge, followed by iron, the syrup. ferr. phosph.

co., being a good form. Finger should be bathed in warm water, and iodoform or boracic ointment applied on absorbent cotton.

2. The disease may commence in the cellular tissue, secondarily attacking the skin, or spread in the contrary direction, from the surface, inwards. It is generally caused by inoculation, through a scratch or punctured wound, by septic matter. The symptoms are more severe than in the preceding form. There is excruciating pain, and swelling; the skin being tightly stretched over the part, and of a red colour. The redness extends to the back and the sides of the finger. The constitutional disturbance is severe, but pus is in small quantity. The tendon of flexor may be attacked, or inflammation spread to hand, or a lymphangitis be set up.

Treatment.—Make a longitudinal central incision, down to bone, by cutting towards the end of the finger; this should be done without waiting for fluctuation. Then alternately poultice and steep finger in hot water. Internally, a purge, followed by liq. ferr. perchlor.

3. Only involves the middle and proximal phalanges, the tendons of the deep flexor ceasing at the base of the last phalanx, though there is a fibrous prolongation from tendon over the terminal phalanx; it may commence as a periostitis, or a cellulo-cutaneous whitlow. Unless treated promptly the finger is apt to be left contracted, deformed, stiff, and useless (*vide* chap. xvii.).

4. The inflammation commences in the bone or periosteum, generally of the terminal phalanx. Symptoms: (a) deep-seated throbbing pain, (b) swelling, (c) more or less redness, (d) formation of pus between the periosteum and bone (periosteal abscess). This generally is associated with the second form, except when the result of traumatic violence; if attacking the middle or proximal phalanges, it is conjoined with the preceding variety. Necrosis is apt to ensue.

Treatment.—Early incision, with above-mentioned treatment. If necrosis result, excise phalanx, or amputate the finger.

CHAPTER VII.

ERYSIPELAS—SIMPLE, PHLEGMONOUS, CELLULITIS.

Causes.—It is an acute specific disease, at first local, and then affecting the whole system, associated with the presence of micro-organisms in large numbers (*micrococcus erysipelatosus*). — Predisposing. Disregard of sanitary conditions, dirt, filth, bad air, crowded neighbourhoods, defective drainage, defect in quantity or quality of food supply, nervous depression from over-fatigue, alcoholism, anxiety, etc., disorders of the menstrual functions, a plethoric or debilitated state of the system, rheumatic and gouty diatheses, the puerperal state, renal diseases and diabetes; the spring and autumn seasons of the year; easterly winds; wet alternating with dry weather. Hereditary influence has some effect. It is often epidemic, and liable to be spread by contagion. Wounds. — Exciting. Inoculation of wounded surface with the *micrococcus erysipelatosus*. Koch has cultivated the micrococci from erysipelas, and has produced a similar disease in animals. Fehleisen has carried the experiment a step further by inoculating human beings, and has never failed to produce erysipelas, or a disease not to be distinguished from it.

Erysipelas Simplex is due to inoculation or infection of a wounded surface, the organisms growing through the lymph channels of the subcutaneous tissues. The local signs are usually preceded by some or all of the following symptoms:—Rigor, headache, bilious vomiting, lassitude, loss of appetite, furred tongue, constipation, thirst, heat and dryness of the skin, rise of temperature 103° to 105° , quick pulse, and feeble respiration. In from twenty-four to forty-eight hours a blush appears at the margin of the wound, slightly raised above the healthy skin, and having a well-defined irregular outline. The colour is intensely red or scarlet, returning instantly after removal of pressure. There is a smarting or burning pain at the part affected, with great tenderness. The redness deepens, the skin appearing tense and shiny; then vesicles form, containing serum, and

soon coalesce. These dry up, producing scabs without any ulceration, and are followed by desquamation. As the disease subsides the pinkish hue dies away, becoming brownish or yellow, but the margin may continue to spread, always having a well-defined edge. Red parallel lines, due to superficial lymphangitis, are often seen along the course of the lymphatics, and the glands are always enlarged and tender before the rash appears. The duration is uncertain. The constitutional symptoms soon assume the asthenic type, and even in the slightest cases there is a tendency to wandering and delirium at night. Erysipelas serpens is the name given to the creeping variety, erysipelas migrans to that variety which disappears from one part of the body and reappears in another. If internal organs are attacked in this way the affection is said to be metastatic. When the disease attacks parts abounding in loose cellular tissue, as the scrotum or eyelids, the swelling is very great, and suppuration may occur.

Diagnosis and Prognosis.—It is liable to be confounded with some of the exanthemata, but the tenderness and enlargement of the lymphatic glands, the character and course of the rash, together with the presence of a wound, are sufficient to distinguish it.

Prognosis.—If the patient is healthy he will probably do well, but if weakened by alcohol, etc., the result may prove fatal. Bright's disease is a very dangerous complication. The seat of the disease has some effect on the outlook, the head and leg being the most unfavourable situations. Infancy and old age are the least propitious periods for recovery to ensue. Should internal organs, as the meninges of the brain, the stomach, etc., be attacked, the prognosis is very serious. In favourable cases the temperature falls on the sixth or seventh day.

Treatment.—Preventive. Due attention to all hygienic principles, free ventilation, cleanliness, avoiding overcrowding. Isolation of the patient affected, and thorough disinfection of the ward.

—Local. Attend to the position of the part, which should be slightly raised. Warmth, by means of fomentations, spongio-piline, cotton wool, absorbent cotton, warm lead and opium lotions, sponges wrung out of hot water. Dusting powders, as chalk and creasote or starch and creasote, dredged over the skin, and covered with wool, oil silk, and a carefully applied bandage. Astringent applications, as solutions of sulphate of iron, alum, lead, equal parts of tar and alcohol. Painting with iodine, solution of bromine, nitrate of silver, collodion, or carbolic oil. A good formula is as follows :—

R Acid carbolici gr. xv
Alcohol ℥xv
Ol. tercbinth ʒss
Tr. iodi ℥xv
Glycerine ʒss. Misce.

To be bathed on the part every two hours.

It has been proposed and practised to inject carbolic acid subcutaneously into the margin of the blush, but of this I have no experience. If these plans of treatment do no good, and there is great tension, small incisions with the point of a lancet are useful, and afterwards the application of poultices.—Constitutional. Keep the patient in a well-ventilated room. To commence with a brisk purge of calomel and colocynth, followed by tr. ferri perchlor. ʒss (every hour or less often), or a similar dose of the liquor. If the fever assume a low type, carbonate of ammonia with bark, or the mineral acids and digitalis. In cases where there is great irritability, extract belladonnae, gr. $\frac{1}{8}$ om. sexta hora. Diet—beef tea, milk and soda water, ice, broth, barley water, light puddings; this should be gradually changed to a meat diet. If the patient be comatose, full doses of camphor and calomel, followed by turpentine and castor oil, with blisters to the thighs and back of the neck. Patients may flag suddenly, especially should large surfaces be affected, and in these cases stimulants, wine, brandy, champagne, or stout, must be given freely by night as well as by day. If the stimulants give rise to dryness and heat of the skin, increased restlessness and delirium, and dryness or furring of the tongue, they are doing harm instead of good, and must be given up or diminished. During desquamation the state of the kidneys must be enquired into, as albuminuria is not uncommon.

Phlegmonous or Cellulo - Cutaneous Erysipelas is much more severe than the preceding variety, the cellular tissue being implicated to a greater degree; it commonly terminates in suppuration and sloughing with purulent infiltration.

Causes.—Generally occurs in persons of broken-down constitution, from intemperance, or diseases of the liver and kidney. A wound penetrating the subcutaneous tissue is the starting point as a rule, but it sometimes starts in the sheath of tendons, especially those of the fingers and hand.

Symptoms.—Local. The part is much swollen, tense, dark dusky red and brawny; soon large phlyctenulae or blebs form, containing a bloody serum. The pain is severe, and of a throbbing, aching character. Suppuration generally occurs about the fifth or sixth day, the part having a boggy feeling, but fluctuation cannot be recognised. The skin is destroyed by ulceration and gangrene. Unlike simple erysipelas, there is no well defined margin. The subjacent cellular tissue becomes converted into slough and pus, and discharges itself through the openings in the skin. As the cellular tissue is more rapidly affected than the cutaneous surface, the latter is undermined and loosened from its connections, the small vascular branches supplying it being the last to give way; if these vessels be not closed by thrombosis (a common occurrence), profuse hæmorrhage may ensue. In other cases considerable portions of the subjacent parts become gangrenous. The ravages of the disease are appalling, the bones may be exposed, joints opened, and huge cavities left, to be slowly filled up by granulations. A variety of this form of erysipelas is termed œdematous, the skin being less involved, and the cellular tissue the seat of œdema from the transudation of serum.—Constitutional. At first of an acute sthenic type, rapidly changing to the asthenic, with much nervous irritability and loss of strength. The temperature is high from the first, 103° Fahr. to 106° Fahr. Death may follow from hectic and diarrhoea, pyæmia or septicæmia, pneumonia or pleurisy. The febrile symptoms, although continued, are often marked by paroxysms and remissions (Dupuytren).

Treatment.—Local. The part must be kept well elevated, all constriction avoided,

and fomentations, or linseed poultices as hot as can be borne, assiduously applied. If in twenty-four hours there be no relief of the symptoms, free incisions two or three inches in length, reaching down to the fascia, must be at once resorted to; if the inflammation extend beneath the fascia, these must be divided on a director. The part must then be treated by antiseptic poultices, and soaking in hot water alternately. If the bleeding be free, elevation of the limb, compresses wetted with hot water, a good large sponge making a very good form with which to apply the pressure when firmly adjusted by a bandage. Gamgee recommends absorbent gauze and cotton wool, digital pressure of the main artery, glycerinum boracis, elastic compression, and infrequent dressing. After-dressings—oakum and carbolic acid. Permanganate of potash, iodine, boracic acid, chloride of zinc, sulphurous acid, hyposulphite of soda, applied as lotions, are all good.—Constitutional is similar to that of simple erysipelas, but the initiatory purging must be more active and the stimulating and supporting treatment most carefully carried out later on.

Cellulitis is a diffuse form of inflammation, affecting primarily the cellular tissue, and not at first implicating the skin. It is always preceded by some wound, especially following poisoned wounds, as those made in dissecting or performing autopsies.

Symptoms.—Local. Great swelling and tension of the part, spreading from the site of the wound, accompanied by intense pain. The skin is unaltered or a little pink, and the affected place feels doughy, pitting on pressure, whilst on careful palpation, deep-seated, indistinct fluctuation can be detected. The rapidity with which the cellular planes of an entire limb are attacked is most remarkable, and the disease then proceeds to affect the trunk. The destruction of tissue is immense. When the skin is cut off from its blood supply by this process, it in turn becomes gangrenous; thus it is common for both the cutaneous and subjacent tissue in or two days to be converted into black sloughs. The lymphatic glands are enlarged, but suppuration is not common.—Constitutional are of an intense asthenic form, with great prostration and excitement of the nervous system. Violent delirium is sometimes present. Death occurs as in the preceding variety.

Treatment is the same as for phlegmonous erysipelas, but the incisions should be made at once without waiting, and must be of considerable length. It is generally necessary to tear through the fascia with a director.—Constitutional. Tonics. Iron, quinine, and the mineral acids with concentrated food. Carbonate of ammonia is of great service; and stimulants, particularly champagne. If cerebral congestion be absent, opium.

SECTION III.

SPECIFIC DISEASES.

CHAPTER VIII.

VENEREAL DISEASES.

VENEREAL DISEASES are those primarily produced by sexual intercourse, and comprise gonorrhœa (*vide* chap. xxxiv.), chancre, and syphilis.

Chancre is a local contagious sore, produced by the inoculation of a specific poison, the exact nature of which is unknown, but quite distinct from that of syphilis. The absorption takes place through an abraded surface; very rarely mediate contagion occurs from the use of towels, unclean instruments, etc., contaminated with chancreous matter. The disease can be conveyed also from a person to a third by means of a second who escapes infection; for instance, a man suffering from a chancre may have connexion with a female, the latter may avoid the danger of absorbing the poison, but on having intercourse with another individual he may be unlucky enough to contract the disease; the woman thus simply being the uninjured carrier of the *materies morbi*.

Seats.—In men: the furrows behind the glans penis, the orifice or inner surface of the prepuce, frœnum, glans, interior of the urethra, but not higher than one-and-a-half inches, on the dorsum or underside of the penis, as far back as the abdomen, and occasionally on the scrotum or belly from self inoculation.—In women: within the nymphæ near the clitoris, the inner surface of the labiæ majoræ, the posterior commissure, the entry to the vagina, and very rarely, on the cervix of the uterus.

Symptoms.—After the inoculation of pus from chancre there is no incubation period. In the first twenty-four hours a papule forms, the next day this changes into a vesicle, about the third day it is transformed into a pustule, and from the fourth or fifth appears as a little ulcer,

which gradually spreads and has the following characters. It is a circular, oval, or irregular sore, with sharply cut edges; a depressed, uneven base, covered with viscid pus, freely movable on the underlying tissue, and perfectly supple; a profuse irritating discharge, which on inoculation produces a similar sore, and hence there are generally more than one ulcer on the patient. In other cases, the base is covered with greyish spongy granulations, causing the so-called elevated variety. A third form is termed ex-ulcerous; the edges are not so sharply cut, and the discharge adherent, the deeper parts of the skin being unaffected. These ulcers may either heal under appropriate treatment, or assume a process of inflammation, rapid sloughing, or slow phagedena. The superficial variety leaves no scar, but the others a permanent cicatrix.

Diagnosis and Prognosis.—The former has to be made from syphilitic sores. That distinguished syphilographer, Berkeley Hill, has most clearly contrasted the differences between these in the table given on the following page.

The prognosis is generally favourable, but in some cases phagedena or gangrene may occur.

Consequences.—Inflammation of the lymphatic vessels, and suppuration of the lymphatic glands of the groin, or bubo. This may be due to simple irritation, or may be "virulent"; in the latter case depending on the transmission of the poison along the lymph ducts, or the accidental infection of the simple kind of bubo by some of the purulent matter from the sore. In phimosi accompanied by chancre, gangrene of the prepuce or glans is sometimes seen.

Treatment.—As general measures, rest in bed, avoidance of stimulants,

LOCAL ULCER (CHANCRE).	SYPHILIS.
<ol style="list-style-type: none"> 1. Incubation <i>nil</i>. Irritation is at once displayed by reddening and speedy ulceration at the point of contagion. 2. Ulceration frequently begins by a pustule. Ulceration is an essential condition, and is always very active during the first few weeks. 3. The virulent character of the ulceration gives the sore the tendency to enlarge, and its long duration, extending in mild cases six weeks, in severe much longer. 4. <i>The aspect of the ulcer is characteristic</i> : it is hollowed, the surface is spongy and undermined, the edges are sharply cut, and the discharge is opaque, yellow, and plentiful. 5. The base of the sore is supple, unless thickened by inflammatory congestion, but the pseudo-induration disappears when the inflammation is subdued. 6. Multiplicity of the sore is the rule. This results from the consecutive inoculation of the parts around with the discharge of the original sore. 7. The lymphatic glands remain either unaffected, or become acutely inflamed, forming an abscess or bubo. 8. The matter of these buboes is often inoculable on the bearer. If so it is pathognomonic of chancre; it also converts the bubo into a chancre. 9. However long the disease last it continues a local disease. 10. Phagedæna and ulceration of the inflammatory kind are frequent complications. 11. Pain of the sore is usually sharp, often severe. 12. Seldom met with away from the neighbourhood of the genital organs. 13. The source a similar ulcer. 14. Antecedent to the disorder the patient may or may not have had syphilis, and may have had similar ulcers several times before. 15. The secretion of the sore is inoculable on the bearer until the ulceration is advanced. 16. The discharge is also inoculable on animals. 17. It may be many times repeated on each individual. 	<ol style="list-style-type: none"> 1. Incubation is always of some length, the average being twenty-four days. 2. The manifestation begins by a papule, ulceration, if accidental irritation is absent, is never active. Superficial erosion is sometimes present as soon as induration begins, but even this is often delayed till the induration is far advanced, and may be altogether absent. 3. The indolent character of the ulceration, of which the duration is uncertain, and depends on the condition of the patient. 4. <i>The aspect of the papule is characteristic</i> : it is often not ulcerous, but simply eroded or desquamating. When the surface is ulcerated it is smooth and covered with adhesive scanty secretion. The edges are not undermined, but raised, sloped, or rounded. 5. The base of the papule is of gristly hardness, independent of inflammatory action; it is peculiar in character; very rarely absent in men, and generally present in women. It usually last several months before it disappears. 6. The papule is habitually solitary. When there are more than one the papules are all of one age. 7. The lymphatic glands are almost invariably affected by slow irregular enlargement of the whole group, at a certain length of time after infection, but suppuration is infrequent, and when present is the consequence of ordinary irritation. 8. When abscesses form round the enlarged glands it is not inoculable on bearer. 9. Between two and three months after contagion, erythematous and papular eruptions appear on the body. 10. Any inflammation or extension by ulceration is rare. 11. Absence of pain. 12. Tolerably frequently met with on parts away from the genitals. 13. The source is most frequently an ulcerating papule of a syphilitic eruption. 14. Antecedent to this the patient has not had syphilis or such a hard based ulcer. 15. The secretion is very rarely inoculable on the bearer, and only so when its surface is irritated into acute suppuration. 16. The discharge is not inoculable on animals. 17. It is only once developed in each individual. Exceptions to this are too rare to invalidate the rule.

and all sexual excitement are to be recommended. The penis and scrotum should be supported by a suspensory bandage. Locally, the sore should be washed twice daily, and iodoform applied. The iodoform, powdered, may be dusted over the ulcer by an insufflator, and covered with lint and oil silk or iodo-carbon paste

(Iodoform pulv. ʒj
Carbo lignis ʒij
Glycerin. amyl. ʒij
Glycerine ʒj
Ol. lavandul. mxx—Gerrard)

may be used. Another excellent form is iodoform ʒjss dissolved in eucalyptus oil ʒj and diluted with five parts of olive oil; or iodoform and oleate of zinc in equal parts. If the pungent odour of iodoform be objectionable, iodol can be substituted. This is an odourless fawn-coloured powder. The following formulæ are excellent :—

R Iodol 3 parts
Alcohol 35 parts
Glycerine 65 parts
Dissolve.

And :—

R Iodol 2 parts
Vaseline 30 parts
Mix.

If the chancre be urethral it must be treated through a speculum. In women, strips of lint soaked in one of the preceding preparations must be kept between the labiæ. Should the chancre become phagedenic or slough, the patient must be immersed in a hip bath as warm as can be comfortably borne for nine or ten hours a day, and iodoform applied in the night. If this plan fail, apply Paquelin's thermo-cautery, the actual or galvanic cautery, or some escharotic as bromine, nitric acid, sulphuric acid and charcoal, or a solution of chloride of zinc gr. v in nitric acid ʒj, thoroughly to the surface and edges of the sore; then dress with carbolic acid lotion, sulphate of zinc lotion, boracic acid, or lot. catechu c. opio. The patient's strength must be supported by a nourishing diet, tonics, and opium. Slow, creeping sores are best treated by a lotion of tartrate of iron. In the case of chancres complicated with phimosis, the best means is to inject frequently under the foreskin, lotions of lead, carbolic acid, or nitric acid ʒj with aqua Oj. If necessary the phimosis must be incised (*vide* chap. xxxiv.).

For bubo, rest is here essential, with the application of a few leeches, and then a pad of absorbent cotton or lint, with a firm spica bandage, may induce the inflammation to subside. If there be much pain, belladonna and glycerine is of service; in some cases nothing answers better than a blister followed by the use of yellow wash (hydrarg. perchlor. and aqua calcis). When the bubo is indolent, a solution of iodine ʒj in glycerine ʒj should be painted over it and the part firmly strapped, or nitrate of silver ʒss—ʒj in water ʒj with the addition of mxx of strong nitric acid. Symptoms of suppuration setting in should be treated by incisions into every pointing part, and lotio catechu injected daily. If fistulæ remain, they must be freely opened and dressed with lint from the bottom. When a gland occupies the wound it should be removed by either the knife or caustic, and medicated poultices applied.

Virulent bubo is managed the same as a chancre. In all cases of bubo, tonics and a liberal diet are necessary. Should hæmorrhage occur, the actual cautery or perchloride or sulphate of iron will arrest it.

Syphilis is a constitutional disease akin to the specific fevers, producing special inflammation in various tissues and organs. In the ordinary form, which is acquired by inoculation during sexual intercourse with a syphilised person, the symptoms assume the following course. After a period of incubation extending from one to seven weeks—the average being three or four—the point of inoculation is the seat of sharply defined *induration*, accompanied by the formation of either: 1. Desquamating papule of a coppery colour, not painful, and slightly raised; this is due to the exudation depriving the superficial layers of nutriment, and thus causing the cuticle to peel off. 2. A superficial ulcer with gently sloping edges; this is the most common initial lesion of syphilis. The induration is thin, a serous fluid exuding from the surface: when this is spread widely it is called parchment induration. 3. Indolent ulcer with a hard base, usually commencing as a papule, which subsequently ulcerates. The sore is rounded, with well marked induration both at the base

and a little outside the margins, the edges are sloped off, the base is smooth and covered by a dirty, adhesive, yellow discharge, and the ulcer is elevated above the surrounding parts. As an accidental occurrence an individual may be inoculated with chancre and syphilis at the same time; then a "mixed sore" will result, resembling a chancre but having an indurated base. In exceptional cases there may be more than one sore; but, if so, this will depend upon the number of places infected in the first instance, and all the sores will be at the same stage of progress.

Seat.—Most frequently met with on the genital organs, but is much more likely than a chancre to appear on a distinct part, especially in women, as female breast, tongue, lip, cheek, eyelid, conjunctiva, ear, palate, chin, gum, nose, neck, thigh, navel, tonsil, margin of anus, etc. In medical men the fingers may be inoculated in the performance of professional duties. Syphilis may be communicated by kissing, suckling, the use of unclean instruments, spoons, pipes, towels, razors, &c. Hutchinson has called attention to the fact that induration may develop in the retro-coronal fold exactly resembling the indolent ulcer, without any fresh contagion. This occurs in those who have had syphilis, and usually in the site of the old one; this may happen repeatedly in the same individual, and may occur at very variable periods after the first appearance of the disease, but commonly within five years.

Transmissibility.—1. By contact of the specific virus with an abraded surface during sexual connexion, etc. 2. By means of the secretions of secondary syphilitic affections, and the blood, as in suckling. 3. Through the discharges of co-existing diseases in syphilitic persons, as exemplified by the transmission of syphilis, by the pus of chancre, gonorrhœa, and by vaccination. It has been most clearly proved that syphilis can be conveyed from one child to another in lymph to all appearances normal, and although the child and the mother may appear healthy. When a patient has once had syphilis as a rule he cannot be again attacked by that disease; but this immunity is not absolute, as second attacks now and then present themselves.

The symptoms of syphilis are arranged into Primary, Secondary, and Tertiary,

and although these three stages are not always distinctly marked, some or all of the symptoms of one division being absent, or co-existing with those of another, still it is convenient to follow this classification for descriptive purposes.

The primary symptoms embrace the local induration and sore already described, these being followed by painless swelling and well-marked induration of the group of glands nearest the initial lesion; thus most commonly appearing in the groin as the most frequent seat is the penis. Indolent bubo is the term applied to the enlarged glands. These never suppurate, and each gland remains distinct. After an interval of from five to seven weeks (second incubation) syphilitic fever arises, accompanied with hyperæmic eruptions (about the forty-fifth day) as roseola and erythema; these are arranged in patches which are symmetrical on both sides, disappear on pressure, are slightly raised, characterised by freedom from pain or itching, assume a copper brown colour before disappearing, and last from two to three weeks. The usual seats are the front of abdomen, front of the chest, front of the arms, the flanks, and along the forehead. Papules may be present which desquamate giving rise to a pseudo-psoriasis. In this stage the throat is affected, being attacked with eartarrh, minute ulcers, and papular eruptions. Occasionally periostitis of several bones occurs as a primary symptom, and very frequently aching pains of joints of a rheumatoid character.

Secondary usually manifest themselves in about the tenth or twelfth week after infection, and last from twelve months to two years. The eruptions which are visible in this stage are characterised by their colour, symmetry, and polymorphism. Papules appear at first of a pink hue, then darker, more elevated, and finally brown and coppery; they attack all parts of the body, and are not irritable; they may enlarge, becoming tubercles, or suppurate, forming pustules, which may spread into unhealthy ulcers. Squamous eruptions are frequently present, usually at front of the arms or back of the legs, but also on the palms, and soles of the feet, giving rise to induration, cracks, and deep fissures. Vesicular eruptions are rare, but still are occasionally seen in the first six months, presenting the ap-

pearance of clusters of vesicles, having coppery stains, or, in debilitated constitutions, running into pustules. Pustular eruptions, yellow, papular, or vesicular, the pustule having a brown areola, and producing large, circular brown crusts (syphilitic ecthyma), which, when detached, disclose an ulcerated surface. In a word, there is no form of skin disease which may not be closely simulated by syphilis. As an accompaniment of these eruptions during the first six or nine months, it is a common event to encounter syphilitic fever; it may be intermittent, resembling ague; continued, simulating typhoid; or irregular, commencing as continued, but afterwards having distinct remissions. Other secondary symptoms are loss of hair, (alopecia), and disease of the nails (onychia). 1. From papules forming in the matrix, destroying the nutrition of the nail, the basis becoming painful and red, suppuration ensuing, with unhealthy ulceration. 2. From atrophy, the nail being brittle, ragged, and notched. 3. The superficial layers may scale off, leaving opaque spots. The fauces and mouth exhibit ulcers of a sharply-cut character; the tongue is the seat of psoriasis, cracks, fissures, and ulcers at the sides. The larynx is attacked by catarrhal and papular phenomena. As a rare event, deafness of both ears may result from inflammatory conditions of the internal ear. The bones, particularly the tibia, clavicle, sternum, os frontis, and bones of the forearm, are the seats of neuralgic pain, depending on periodical inflammation, worse at night (osteocopic) and migratory in position. Chronic synovitis occasionally displays itself at this time. Iritis is not uncommon, characterised by the rapid effusion of lymph, which may be seen as yellowish nodules along the margins of the iris, and the absence or little severity of pain and photophobia. One eye is generally affected subsequently to the other, even in spite of appropriate treatment of the first. Condylomata and mucous tubercles are large, flat, smooth circular elevations with hard bases, and discharging an exudation of a highly contagious nature; they are most usually met with at the junction of the mucous membrane and the skin, as anus, vulva, and mouth, etc. After the patient is apparently well there is an intermediate period in which he is

liable to relapses. Hutchinson notices as a characteristic symptom when present, an erythematous ringed eruption on the limbs and trunk, especially visible after exposure to heat or cold. I have seen several instances of this. Other symptoms are patches and sores on the tongue, patches on the scrotum, or a scanty general papular eruption, and palmar psoriasis.

Tertiary appear about five years after infection, and at this period the disease is not contagious. Rupia, or the formation of bullæ, drying into brownish green thick scabs of a conical shape, like a limpet shell. Hutchinson considers this to be a late secondary symptom, and certainly sometimes it is so, but it may also be tertiary; it is never present in hereditary syphilis. Serpiginous ulceration, healing on one side and extending on the other, is a very characteristic tertiary phenomenon. Tubercular syphilides, consisting of hard, smooth, flat elevated nodules of a coppery brown colour, affecting the skin and subjacent cellular tissue, and tending to ulcerate, most frequently situated in the face (syphilitic lupus). All these cutaneous appearances exhibit an absence of that symmetrical arrangement, which is so common in the secondary eruptions. In addition to these superficial changes, two pathognomonic processes take place in various deep tissues and organs. 1. Fibroid induration, or the formation of a granulation tissue and its conversion into a fibrous structure; in the liver, causing peri- and interstitial hepatitis and cirrhosis; thickening of the submucous tissue of the larynx and trachea, cirrhosis of the lung (syphilitic phthisis); interstitial induration of the fibrous stroma of the testicle, and obliteration of the glandular acini (this is an early tertiary symptom); interstitial nephritis; fibrous stricture of the rectum; sclerosis of arteries. 2. Gummata: these are new growths due to small limited inflammation. Each gumma consists of a central portion of granular debris, fatty matter, and cholesterin, and is utterly devoid of vessels; encircling this is a fibrillated tissue, whilst outside the latter is a highly vascular granulation tissue. The gummata form solid yellowish white nodules, and are met with in the skin, subcutaneous and submucous tissues, muscles, tendons, bones, liver, brain, testicle, kidney, and occasionally

in the lungs and breast ; when situated in the mucous tissue the mucous membrane is destroyed, occasioning deep, circular ulcerations. The ulcers produced by these new formations are always characterised by their round, deep, punched-out appearance, and are often multiple. Among the tertiary symptoms are caries and necrosis of the bones with the formation of nodes or gummata of the periosteum: endarteritis leading to aneurism ; choroiditis and retinitis ; and as a late tertiary manifestation, enlargement of the fingers and toes (dactylitis), from implication of the connective tissue and fibrous structures round the joint, periostitis, or osteomyelitis. Diseases of the brain and spinal cord. Gowers gives as those of common occurrence : " Subacute and chronic meningitis, cerebral or spinal. The cerebral form causing headache, convulsions, mental changes, paralysis of cranial nerves ; the spinal causing pain, spinal and eccentric acute spasms, weakness in the limbs, scattered anæsthesia, and muscular wasting. Growths—in the brain, causing headache, unilateral convulsions, paralysis, and optic neuritis ; in the cord, causing paralysis affecting usually one limb before another. Vascular obstruction in early adult life, causing a sudden hemiplegia, often preceded by premonitory symptoms. Multiple lesions, especially involving the cranial nerves. Locomotor ataxy, iridoplegia, epileptiform convulsions in adult life beginning locally.

Occasionally due to Syphilis.—Chronic myelitis, muscular atrophy, sclerosis of cerebral convolutions ; subacute mania, the irregular form of general paralysis of the insane ; neuralgia.

Rarely due to Syphilis.—Acute meningitis and myelitis, glosso-laryngeal paralysis ; cerebral hæmorrhage ; chronic hydrocephalus, local muscular spasm.

Sequelæ.—Various degenerations of organs, as the kidney, liver, brain, etc., from waxy, lardaceous, or albuminoid degeneration.

Treatment.—*General.* Mercury is the most reliable drug in the primary and secondary stages of the disease : it may be administered by the mouth, by vapour bath, inunction, or subcutaneous injection. *By the mouth:* Pil hydrarg. co. in doses of gr. ij to iij, combined with $\frac{1}{4}$ gr. of opium, three times a day at first and afterwards twice ; grey powder,

gr. j, with Dover's powder, gr. ij ; calomel, gr. ss to j ; bichloride of mercury, gr. $\frac{1}{10}$ th in pill ; and, perhaps, best of all, perchloride of mercury, in one of the following forms, viz. :—

℞ Liquor of Van Sweiten, composed of
hydrarg. perchlor. 1 part
Aqua 900 parts
Alcohol 100 parts
Dose, ʒss in water.

Or,

℞ Hydrarg. perchlor. gr. ij
Tr. ferri perchlor. ʒj
Aq. ad. ʒiv M.
Dose, ʒj in water.

Or,

℞ Liq. hydrarg. perchlor. ʒj
Pot. iod. ʒss
Sp. ammon. arom. ʒss
Aq. ad. ʒviiij
Dose, ʒj in water.

In scaly affections the hydrarg. iodid. rubrum gr. $\frac{1}{16}$ to $\frac{1}{4}$ in pill is useful, but in my opinion is better given as in the preceding prescription. *By inunction :* In weak patients, this is a good method, the ung. hydrarg. being rubbed into different places at each application. The most suitable places are the sides of the chest and abdomen, inner sides of the thigh or arm. The patient stands in front of a fire whilst the inunction is taking place, the best time being at night ; he then puts on a flannel dressing gown and goes to bed ; the ointment is washed off in the morning. *By subcutaneous injection* is of great service, if it be desired to banish the symptoms promptly ; for instance, when the face is affected, as the system is very quickly influenced by the drug when thus administered, the following formulæ are serviceable :—

℞ Hydrarg. iodid. rubrum. gr. iv
Sodii iodid. q.s.
Aq. destill. m 256. M.

The needle must be washed after the requisite dose is drawn into the syringe to prevent the mercury irritating the skin. The usual dose is m x to xij, injected into the substance of the muscles in the upper part of the nates, loins, or infra-scapular regions.

℞ Hydrarg. perchlor. gr. xl
Glycerine ʒj
Aq. destill. ʒvj. M.
Dose, m xij for one injection.

Mercurial vapour baths are excellent if the skin be much affected, calomel being usually employed for this purpose.

The constant rule in treating cases of

sypilis by mercury is "small doses for a long period." The drug should be given for a period of at least a year after infection, the course being stopped from time to time for a week or so, and then renewed. The mercurial treatment should not be discontinued until three months have elapsed since the disappearance of the last symptom, however long after the infection that may be. Mercury should only be given where the patient is well nourished, in fair health, and pretty strong: whilst under its influence all stimulants, cold, over-exertion, sexual intercourse, and sources of irritation should be avoided. If continued too long, or in too large doses, or sometimes due to peculiarity on the part of the patient, symptoms of poisoning may arise; the gums swell, become tender and spongy, bleeding easily, with a red line at junction with teeth, sloughing and exfoliation of bone may result, the tongue is swollen and the parotid gland, whilst aphthous ulcers form on the cheeks, gums, etc. The breath is fetid, there will be a metallic taste in the mouth in the morning, and the saliva will be enormously increased. At the first sign of salivation and affection of the gums, the drug must be suspended, the mouth washed out with chlorate of potash gargle; purgatives, colocynth and sulphate of magnesia, administered, and leeches applied if the tongue or salivary glands are much swollen. If there be much salivation, hypodermic injection of sulphate of atropia is of service: should the gums be spongy and the teeth loosened,

R Acid. nitric. dil. ʒiv

Aq. ʒij. Misce.

Dose ʒj in water every four hours.

A rapid loss of weight is a sign mercury is disagreeing, and the dose must be decreased. The administration of mercury should always be followed or combined with tonics. The diet must be good and nutritious, and flannels are necessary. In the tertiary stage, iodide of potassium is of cardinal importance; it should be given after meals in gr. v to x doses to begin with, and gradually increased to gr. xxx to xl, or even more; it should be combined with ammonia or bromide of potassium, and freely diluted with water, or Vichy water, to lessen the chances of iodism. The symptoms of this occurrence are coryza, frontal headache,

running from the eyes and nose, acne, etc.; these will disappear on discontinuing the drug. If the iodide of potassium cannot be borne, that of sodium or ammonium should be tried: a good plan is to give the three together, with sp. ammon. arom. and tr. belladonna. Iron and cod liver oil are often necessary as—

R Potass. iodid. ʒv

Vin. ferr. ʒiv. Misce.

Dose ʒj t.d.s.

Donovan's solution is effective in scaly diseases. In obstinate tertiary affections iodoform in pill, gr. j to iij is useful, or tr. of iodine mx in starch water, or subcutaneous injections of iodoform (iodoform, 1 part; sulphuric ether, 5 parts; and olive oil, 5 parts). If iodide of potassium does not remove the symptoms, it must be combined with mercury, as in "Sirop Gibert," composed of—

Hydrarg. biniodidi gr. j

Potass. iodid. ʒj

Aq. ad. ʒj.

Filter through paper and add

Syrup. simplicis ʒv. Misce.

Dose ʒss.

Another good prescription is—

R Hydrarg. perchlor. gr. j

Potass iodid. gr. xvij

Tr. iodid. co. mʒj

Aq. ad. ʒj.

Dose ʒj to ʒij.

Local. Black or yellow wash to the sore if there be one; if not, oleate of mercury (5 per cent) to the induration. If suppurating, iodoform in powder or as an ointment with vaseline; should phagedena set in, cauterise it with one of caustics mentioned when speaking of chancre, then treat by immersion in warm bath (*vide* Chancre). For skin rashes, the mercurial vapour bath if possible, otherwise oleate of mercury diluted with vaseline. Should alopecia be present, bi-chloride of mercury, glycerine and tannin, form a good lotion; or glycerine, oil, and tr. cantharides in equal parts; or tannic acid gr. vj, sulphate of copper gr. ss, in sp. tenuior ʒj. Mucous patches should be painted over with a solution of nitrate of mercury, or dusted with a powder of calomel and oxide of zinc. Ulcers in the mouth should be touched with nitrate of silver, and perchloride of mercury solution used to gargle the throat. Richardson recommends in obstinate

syphilitic ulceration of the fauces, a spray composed of

Sodium iodide ℥ss
Tincture of myrrh ℥j
Rectified spirit ℥ij
Distilled water ℥vj.

For the nose the douche should be used frequently with Condyl's fluid or tr. iodi. much diluted, and ulcers treated with ung. hyd. oxid. rub. or bougies of iodoform and gelatine. If the larynx be affected, inhalations of iodine, benzoin or creasote, as tincture of iodine ℥xl, hot water 10 oz., or comp. tincture of benzoin ℥j to 20 oz. of water, at 150° Fahr., or creasote half oz., light carbonate of magnesia 90 grs., water to 3 ozs., mix. ℥j in a pint of water at 150° Fahr. for each inhalation. For periostitis, blisters and spirit lotions, or lin. iodi., and if suppuration ensue, poultices and incisions; dress resulting wound with iodoform: in these cases large doses of iodide of potash internally are imperative. In iritis, solution of atropia, mercury, blisters dressed with mercurial ointment, and leeches. Opium to relieve pain. Large doses of pot. iod. soon cause absorption of a gumma. It has been well observed that in doubtful or difficult cases of any disease it is well to try the effect of iodide of potassium, as many of these are syphilitic. In all worn out and debilitated cases give opium; the effect is often wonderful.

Hereditary Syphilis is that acquired by the fœtus from either parent. 1. The father may be suffering from syphilis, and may communicate it to the child ab initio by means of the semen, with or without infecting the mother. 2. In a like manner, the mother being syphilitic the ovum may be tainted. 3. During pregnancy, the mother becoming affected the child may contract the disease through the agency of the placental circulation, the blood being contaminated. 4. Conversely, the child if syphilitic always gives the disease to the mother.

Symptoms.—Syphilitic disease frequently occasions abortion; but should the pregnancy proceed to the full time, the child is born to all appearances healthy, and it is not for about three weeks to a month that symptoms manifest themselves. The child at this period constantly cries, is feverish, wastes, and obtains the appearance of a little old man; his skin is wrinkled, hangs in loose folds, and assumes a muddy hue.

It becomes erythematous, of a dull red colour, and cracks, forming bleeding fissures around the nose, mouth, anus, scrotum, and vulva. The hair, eyebrows, and lashes fall off, and the mucous membranes are affected by ulceration. The child's voice presents a metallic cracked sound, from his nose being the seat of inflammation and ulceration of the mucous membrane, and he makes a very characteristic snuffling noise as he breathes, owing to thickening of the mucous membrane and collection of hard mucus; mothers frequently bring their children to the surgeon on this account, saying that they are affected with the snuffles. Condylomata are common round the anus. The eruption in cachectic subjects may take on a pustular appearance, progressing into ulceration, or bullæ may form at birth or within a week or ten days, on the hands and feet (pemphigus); the skin peels off, and this is followed by marasmus, and usually the death of the patient. Onychia may appear. Later on the permanent teeth become implicated, being small, of a bad colour, with the base larger than the cutting edge (pegged), and the edges of the central incisors marked by a vertical notch (Hutchinson's teeth). Deafness of both ears, due to chronic inflammation of the middle ear and thickening of the membrana tympani. Hutchinson writes, "If a child or young person, without either earache or otorrhœa, becomes quickly and completely deaf, it is almost certainly syphilitic." Caries and necrosis sometimes occur. Fibroid enlargement and gummata of the spleen, liver, etc. Enlargement of the testicle from two to fifteen months may be met with. Affections of the eye are common. Iritis, kerato-iritis, choroiditis and retinitis (*q.v.*). Interstitial corneitis or keratitis is pathognomonic of syphilis. It occurs from five to eighteen, the cornea becomes covered with minute spots of opacity, causing it to look like ground glass. The deposit begins centrally and the second eye becomes affected from one to three months after the first. The duration is from twelve to eighteen months. It is often accompanied by chronic synovitis (*vide* chap. xliii.).

The osseous system, next to the cutaneous structures, is most frequently affected by hereditary syphilis. The bones most often invaded are the long bones, as the

tibia and humerus, then the cranial bones, ribs, scapula, and ileum. In the long bones the periosteum may be primarily attacked (Periosteogenesis), or the ossifying line of cartilage (osteochondritis). Periosteogenesis is divided by Parrot into the osteoid, and rachitic or spongeoid forms. The osteoid form consists in a bony swelling from one-tenth to three-quarters of an inch in thickness, placed underneath the thickened periosteum. The spongeoid or rachitic variety occurs at five or six months, and manifests itself as a bony growth with a fibroid structure, more vascular than normal bone, and containing but little marrow; at the same time the shaft undergoes rarefying osteitis, and the epiphyses are enlarged in a manner analogous to rickets. In osteochondritis changes also occur similar to rickets, and in addition gelatiniform atrophy. There is difficulty in motion and limited control over the limbs often accompanied with much pain. On careful palpation the osteophytes can be detected.

Treatment.—The mother should suckle the child if possible, if not, it must be brought up by hand,—as a wet nurse might be infected. Mercury must be given either by hydrarg. c. creta gr. j twice a day, or by mercurial ointment spread on flannel and stitched round the waist or thigh, or the ointment may be rubbed in the soles of the feet. Cod-liver oil, syr. ferr. phosph. co. or syr.

ferr. iod. may be administered afterwards, when all the symptoms have disappeared, with small doses of iodide of potassium. For the treatment of the eye affections the reader is referred to chap. xliii. If the mother be known to be syphilitic, she should have a course of mercury by inunction during pregnancy, and if whilst suckling a child symptoms of hereditary syphilis appear in it, the mother should also take mercury.

Diet.—In addition to the breast, the child should have twice a day a bottle of peptonised cow's, ass's or goat's milk diluted with veal or chicken broth. If brought up by hand, the milk should always be peptonised, Fairchild's peptonising powders being very efficacious and easily manipulated; where these cannot be procured, lime water should be added to the milk. In vomiting and emaciation, cream and lime water is sometimes retained, and brandy well diluted is useful. I have found of immense service fresh arterial blood from the heart of the bullock, mixed with milk, as recommended by Abrath. The blood in a small earthen pot is placed in a saucepan of warm water, and stirred until it becomes fluid, when it is mixed with the milk, and a teaspoonful of saccharum lactis added. Two tablespoonfuls of blood to a bottle of milk is sufficient. In older children raw rump steak pounded up is of use.

CHAPTER IX.

TUMOURS.

A TUMOUR is a new formation in some tissue or organ of the body, depending on excess of, or deviation from, the normal nutrition of the part, and not resulting from inflammation only. Tumours are divided into "malignant" and "non-malignant," the latter being also termed "harmless," or "benign;" another division is according to whether they resemble the tissue from which they spring, in this case being called homoplastic; or differ from it, heteroplastic. A malignant tumour is characterised by: 1. Invasion and infiltration of the surrounding tissues; 2. Rapid growth; 3. Implica-

tion of adjacent lymphatics; 4. Occurrence of similar growths in internal organs; 5. Constitutional cachexia; 6. Recurrence after removal.

Tumours of the Connective Tissue Type.—These embrace Sarcoma, Fibroma, Myxoma, Lipoma, Enchondroma, Osteoma, Lymphoma.

Sarcomata.—Billroth defines a sarcoma as a tumour consisting of tissue belonging to the developmental series of connective tissue substances, which, as a rule, does not go on to the formation of a perfect tissue, but to peculiar degeneration of the developmental forms. This

group contains tumours composed of cells of various shapes, a sparse intercellular substance more or less fibrillated, and numerous blood vessels with their walls in contact with the cells. Their seat is the connective tissue, the subcutaneous, submucous, and subserous tissues, fasciæ, periosteum, medullary tissue of bone, and the connective tissue of organs. They usually extend by a peripheral, but occasionally by a central growth, and are liable to undergo secondary changes, as fatty degeneration, softening, caseation, pigmentation, calcification, ossification, chondrification, mucoid degeneration, and the formation of cysts. Sarcomata are classed into: 1. Spindle-celled; 2. Round-celled; 3. Myeloid or giant-celled; 4. Mixed-celled.

Spindle-celled Sarcomata are of two kinds, the large and small celled. They consist of spindle-shaped, oat-shaped, or fusiform cells, each containing an oval nucleus with nucleoli; the cells are arranged in parallel bundles, and in addition there is a very sparse intercellular substance. They grow from the periosteum, fasciæ, connective tissue, muscles, skin, testicle, eye, nerves, bone, and breast, and are usually encapsuled at first; their mode of growth is peripheral. They are of firm consistence and fibrillated appearance on section.

Melanotic Sarcomata are merely a variety of the preceding, in which some or all of the cells are filled with dusky pigment granules. Their most common situations are the choroid coat of the eye, the skin, and subcutaneous cellular tissue; they are frequently multiple and excessively prone to give rise to secondary tumours in the liver, spleen, kidney, etc., the secondary growths being themselves generally of a pigmented character.

Ossifying Sarcoma is another form of the spindle-celled group, occurring in connexion with the periosteum or medulla of bone, in which portions of the tumour are infiltrated with calcareous matter converted into true bone.

Round-celled Sarcomata may also be large or small celled. They are composed of round cells containing a nucleus and bright nucleoli, and a soft, granular, intercellular substance. They are of a soft brain-like consistence, yield a juice on scraping, are very rich in

vascular supply, of a pinkish or yellowish grey colour, and often contain cysts. The seats are the skin, subcutaneous cellular tissue, periosteum, antrum, fasciæ, and the connective tissue of organs, as testicle, lymphatic glands, tonsil, etc. Their growth is peripheral, and there is great liability for the secondary affection of the lymphatic glands and internal organs; when occurring in connection with glands, bones, and subcutaneous tissue, they are not uncommonly multiple.

Myeloid Sarcoma or Giant-celled Sarcoma consists of myeloid cells similar to those met with in the fœtal marrow, and composed of large masses of protoplasm, often branched, and containing several large round or oval nuclei with nucleoli; in addition there are spindle cells, some round cells and a very scanty intercellular substance.

Seat.—It generally occurs in connexion with bones, the ends of the long bones, chiefly the head of the tibia, and lower end of the femur, radius, and ulna, and about the jaw, constituting epulis. When endosteal in formation, the bone is thinned and expanded over the tumour, occasioning on palpation the so-called "egg-shell crackling." Its consistence is firm and growth slow: on section it presents a glistening reddish brown or yellow appearance, mottled with pinkish or brown patches. It is usually met with before or about middle life, and is encapsuled.

Mixed-celled Sarcomata occur in many of the parts where sarcomata are met with, but most commonly in connexion with bones. The cells are of varying shape, some spindle, some round, and some myeloid, and of all sorts of sizes. The mixed-celled tumours are, as a rule, very malignant, and secondarily most often affect the lungs.

Characters.—The sarcomata occur before the middle of life, in connexion with growing or developing organs or tissues, and rank in malignancy next to cancers. They spread by infiltrating the surrounding tissues. This circumstance should be considered in their removal, or they will be likely to recur. The round-celled variety is the most malignant, the myeloid the least so; but all these growths differ widely in this respect, some being almost benign, others excelling the carcinomata in malignancy.

They do not so often affect the lymphatic glands as cancers, but this will much depend on their situation; for instance, sarcomata of the testis, tonsil, and mediastinum invariably occasion glandular infection. They spread to internal organs by means of their cellular elements being conveyed in the blood, which the thinness of the walls of their numerous vessels greatly assists. The organ most often attacked is the lung. It must be remembered that innocent tumours sometimes change into sarcomata, or a growth may be partly sarcomatous and partly benign.

Treatment.—Extirpation by the knife, or amputation, if a bone be affected. Internally, iodide of potassium.

Fibroma, or Fibrous Tumour, consists of connective tissue resembling that normally met with in the body. It is chiefly made up of nucleated fibres, in interlaced bundles, or arranged concentrically around the blood vessels, together with a few branched connective tissue corpuscles with an oval nucleus. The consistence of these tumours varies, and so they are divided into soft and hard, to which may be added fibrous polypi. The soft forms contain mucous tissue. The vascular supply is poor.

Seat.—Of soft fibromata—the skin and subcutaneous tissue, forming *diffuse fibromata* and wens; they have no capsule.

Of hard fibromata—Fasciæ, bones, periosteum, neurilemma, testes, mammae, parotid region, and uterus. Fibrous epulis of the jaw is a common example of this kind of tumour. Of fibrous polypi—The nasal sinuses, antrum, and pharynx; mucous surfaces, as vagina, uterus, stomach, and intestines; and the skin, constituting molluscum fibrosum; in latter case they are usually multiple.

Fibromata, when first formed, are composed of a granulation tissue, which gradually becomes developed into connective tissue of varying consistence. They are subject to calcification, mucoid degeneration, and ulceration. In form they are usually spherical, and on section present a white, glistening, fibrous structure; the firm variety is hard and creaking to the knife, whilst the soft resemble mucous tumours. They are almost invariably single, except when occurring

in connexion with the cutis, uterus, or neurilemma; are harmless, not recurring after removal, and slow in their growth.

Treatment consists in extirpation by the knife, etc.

Myxoma, Mucous, or Gelatinous Tumour consists of delicate, branched, anastomosing cells, each containing a single nucleus; and also some fusiform, oval, or spherical cells, together with an abundant soft, viscid, gelatinous, intercellular substance, which yields mucin on boiling. The blood vessels are few, and have distinct walls, but easily rupture.

Seat.—Adipose tissue, either subcutaneous, submucous, or intermuscular; medulla of bone; connective tissue of organs, as brain, spinal cord, salivary glands, vulva, placenta, and breast; the neurilemma; and they are frequently met with forming the mucous polypi of the nose. They are encapsuled, increase but slowly in size, are liable to hæmorrhage, forming cysts, and to mucoid or fatty degeneration of their cells. In consistence they are soft, semi-translucent, and gelatinous; their colour is grey or pink; on section the surface gives off a mucilaginous fluid. They present themselves chiefly in adult life, are, as a rule, harmless, not recurring after removal, but, if unmixed with other tissues, are as malignant as the sarcomata.

Treatment.—Extirpation by the knife, or, for polypi, by ligature, forceps, écraseur, etc.

Lipoma, or Fatty Tumour, consists of round or polygonal cells containing oil or fat globules, together with connective tissue dividing the tumour into lobules, forming a capsule and containing the blood vessels; occasionally there is no capsule (*diffuse lipoma*).

Seats.—The connective tissue, especially the subcutaneous, intermuscular, subserous, subsynovial, and submucous; also in internal organs. It is liable to occur in parts exposed to pressure, as the lower part of the neck, shoulders, and arms, from the braces in men or the stays in women; but the tumour may shift in position. It is most common from thirty to fifty, and is occasionally hereditary. It may undergo calcification, mucoid degeneration, or become inflamed and suppurate; on section it presents the appearance of adipose tissue. One or many may exist; it is painless, slow

in growth, but may reach a large size; lobed and circumscribed in outline, freely movable, semi-fluctuating, and often has the surface dimpled; as a rule the growth is perfectly harmless. Women seem more liable to the affection than men.

Treatment.—Make an incision in the middle of the tumour in the direction of the muscular fibres, and turn it out of its capsule by putting the fingers under the lobules. In diffuse lipoma give liquor potassæ (m x t. d. s.) for a long period; no operation is to be recommended.

Chondroma, Enchondroma, or Cartilaginous Tumour, resembles cartilage, and consists of round, oval, spindle-shaped, or branched cells, containing one or more nuclei; an intercellular substance, hyaline, granular, fibrous, or mucoid; and thirdly, fibrous tissue, dividing it into lobules, containing the blood vessels, and forming the capsule.

Seats.—Bone, connective tissue, and rarely cartilage, when it is termed an enchondrosis. 1. The fingers and the toes are favourite situations. 2. Ends of the long bones, pelvis, scapula, and jaw bones, particularly the upper. 3. Soft parts, as the parotid, testis, mamma, submaxillary, sublingual, and lachrymal glands, and the lungs. The consistence is softer than true cartilage, and in some varieties gelatinous. It is usually single, unless occurring in the fingers and toes, where multiplicity is very common. The tumour is recognised by its hardness, slow and painless growth, round or nodular surface, and its elasticity; the hard chondromata yield chondrin, the soft ones mucin. Changes which may ensue are calcification, ossification, fatty and mucoid degeneration, and ulceration. Various varieties are met with depending on the tumour assuming the type of hyaline, fibrous, or mucoid cartilage; another form is ossifying chondroma, consisting of imperfectly ossified bone and some cartilage; it is commonly situated under the periosteum. The favourite time for the appearance of this growth is in childhood or youth, and, as a rule, it is perfectly harmless, but in some cases associated with sarcoma, particularly if occurring in the soft parts.

Treatment.—Excision of the tumour, when possible, or amputation of the affected part.

Osteoma, or Bony Tumour, resembles bone in structure. Three kinds are met with. 1. Ivory, occurs in the skull, is composed of dense osseous tissue, with concentric lamellæ parallel to the surface, no cancellous structure, and small blood vessels; on section it presents a granular appearance, like ivory: it is most commonly found on the scapula, flat bones of the skull, and the lower jaw. 2. The compact, resembling the compact tissue of bones; this chiefly affects the flat bones and the jaws. 3. Spongy or cancellous, similar to the cancellated structure of bones, having an external layer of compact bone covered by hyaline cartilage and periosteum: it grows usually from the long bones at the junction of the epiphysis with diaphysis; more especially the femur, tibia, and humerus. Cancellous osteoma occurs during youth, but the compact are met with in adults between thirty and forty years of age.

Seats are the bones and periosteum: the bones most frequently affected are the femur, tibia, upper and lower jaws, orbit, humerus, the distal phalanx of the great toe, scapula, bones of the cranium, and the vertebrae; occasionally in the interior of the brain, the eye, lungs, and the testicle. It is recognised by the situation, hardness, fixity, and slow and painless growth.

These tumours are often hereditary, multiple or bilateral, painless, except from pressure effects, slow in growth, and harmless, unless associated with sarcoma.

Treatment.—Excision by the cutting pliers, Hey's or chain saws, chisel, or gouge. The osteoma of the great toe should be exposed by an oval incision, and cut off with the pliers, amputation being inadmissible. Exostoses of the bones of the skull and osteomata of the bones of the face are not often capable of removal; when an osteoma occurs in the neighbourhood of a large joint, an operation is not advisable unless there be some special indication, as the risk to life and the joint are too great to be needlessly incurred.

Lymphoma, or Lymphatic-tissue Tumour, consists of a network of fine fibrils containing, in its meshes, lymph corpuscles, resembling the white corpuscles of the blood; in the early stages of growth the corpuscles are in excess, in the later the stroma.

Seats. — Lymphatic tissue, especially the cervical, submaxillary, axillary, inguinal, bronchial, mediastinal, and abdominal glands. The consistence varies, in the newly formed tumour being soft and brainlike, in the old, hard. It is non-malignant, as a rule, but occasionally malignant, and then often associated with sarcoma. The blood is not changed in these formations. In lymphadenoma, or Hodgkin's disease, in which the glands and gland tissue are invaded, with similar growths in the spleen, liver, kidneys, skin, etc., the disease is malignant, and is accompanied with an increased number of colourless blood corpuscles in the blood.

Treatment. — Remove all causes of irritation. Friction with iodine, or iodide of lead ointment, and internally liquor arsenicalis, iodide of iron, and cod liver oil; occasionally extirpation with the knife or electrolysis is necessary, but such operations with the knife should not be lightly undertaken, as they often involve extensive dissections. In lymphadenoma, iodine internally gradually increased and continued for a long period. Alcohol and ethereal solution of phosphorus, gr. $\frac{1}{50}$ to $\frac{1}{15}$, twice or three times a day.

Tumours of the type of Epithelial Tissue comprise papillomata, adenomata, and carcinomata.

Papilloma, or Warty Tumour, is composed of enlarged papillæ, formed of a base of richly vascular connective tissue, loops of blood vessels, and a covering of epithelium.

Seats. — The skin, and mucous or serous surfaces, forming corns, warts, condylomata, polypi, and horny growths. Papillomatous polypi are met with in the bladder, the gastro-intestinal tract, and the larynx. These tumours may undergo hæmorrhage and ulceration; they are occasionally pigmented, and now and then assume a transformation into sarcoma or carcinoma. A papilloma is harmless, but may occasion death by ulceration and hæmorrhage.

Treatment. — Extirpation by caustics, écraseur, knife, ligature, etc.

Adenoma, or Glandular Tumour, consists of convoluted tubes lined with squamous or cylindrical epithelium, arranged in a racemose manner round a common tube, which acts the part of a stalk to the bunch. The branches

are separated by a stroma of connective tissue (racemose adenoma). Another form resembles the structure of the long tubular glands, as the crypts of Lieberkühn (tubular adenoma). It consists of long tubes, each having a membrana propria, with a layer of regularly arranged columnar epithelium; the tubes are frequently branched and connected by a quantity of fibrous connective tissue.

Seats. — Glandular structures, as mamma, testis, parotid, prostate, mucous membrane of nose (forming one form of nasal polypi), pharynx, lips, thyroid, stomach, intestines, vagina, and uterus. The growth may undergo cystic, fatty, or mucoid degeneration; it is usually encapsuled, and of a hard consistence. On section it presents a lobulated appearance, and the convolutions are visible. It is usually single, but may be multiple; harmless, unless associated with sarcoma or carcinoma; and its growth is slow, being generally of a moderate size. When not congenital, it is always developed during adult age.

Treatment. — Friction with iodine, etc. Pressure. Removal with the knife, etc.

Carcinoma, or Cancer. — There are three forms of this tumour, depending on the character of the epithelium composing it. 1. Spheroidal-celled or glandular-celled, (a) scirrhus, (b) encephaloid. 2. Squamous-celled or epithelioma. 3. Columnar-celled or cylindrical-celled. Rodent ulcer is also considered structurally to belong to the carcinomata, but clinically is quite distinct. 1. Spheroidal-celled or glandular-celled. (a) Scirrhus consists of a dense fibrillated stroma, forming spaces or alveoli, which contain large epithelial cells of a round, oval, fusiform, caudate, or polygonal shape, inclosing one or more large round or oval nuclei, with bright nucleoli; the cells are often granular. An important fact is that no intercellular substance exists, the cells simply floating in a liquid or juice. The stroma contains the blood vessels, which are scanty, and the lymphatics, the latter terminating within the alveoli. It always commences as a proliferation of glandular epithelium, extending into the surrounding structures. The alveolar spaces are formed by the irritation and proliferation of the connective tissue elements, which develop into connective tissue surrounding the young, growing epithelial cells.

Seats.—Mamma, œsophagus, pylorus, sigmoid flexure, rectum, tongue, penis, skin, tonsil, bone, testicle, eye, and secondarily in the lymphatic glands, pleura, lung, liver, and bones.

On section it presents a concave white, or bluish white glistening surface, having an irregular margin; it is intersected with white bands, and yields on scraping a milky juice. In consistence it is firm and stony hard. It is usually depressed in the centre from contraction of its fibroid tissue.

(b) Encephaloid or medullary differs from the preceding in its greater rapidity of growth, small amount of stroma, which is less fibrillated, and the much greater amount of cells and blood-vessels. The alveoli are larger than in scirrhus.

Seats.—Breast, testis, stomach, bladder, rectum, and skin; secondarily to other forms of cancer in the internal organs. On section it presents a soft, white, pulpy mass, similar to brain substance, and usually stained with bright or dark red patches of extravasated blood. It quickly attains a large size, and is soft, elastic, and semi-fluctuating in consistence; on scraping it yields a milky juice, diffusible in water. The spheroidal-celled carcinomata are liable to fatty and caseous degeneration.

Colloid is another change which may occur in this group, the cells of one of the preceding varieties having undergone a colloid or mucoid change, and thus being filled with a clear, semi-transparent, glistening, glue-like or gelatinous material. This also invades the stroma, and embeds the cells, which are large from distension with this substance, and often marked with concentric lines. The secondary growths are similar to the primary.

Seats.—Generally the abdominal viscera or stomach, intestine, pancreas, omentum, peritoneum, and ovaries.

2. *Squamous-celled, or Epithelioma*, consists of cells with one or more nuclei, often flattened or distorted similar to squamous epithelium, together with a stroma composed of fibrillated or granulation tissue, and containing the blood vessels. The epithelial cells proliferate and invade the adjacent tissues in a columnar manner, the columns following the direction of the hair follicles, sweat ducts, etc., and resulting from excessive development of the interpapillary process

of epithelium. The rod-like cylinders send off buds in different directions, which form the "epidermal concentric globes," pearls, or nests, as a result of rapid endogenous multiplication. These laminated nests are very characteristic.

Seats.—Most common at the junction of mucous and cutaneous surfaces, as the lips, mouth, eyelids, penis, labia, and anus; in mucous surfaces, as the tongue, antrum, vagina, uterus, œsophagus, larynx, and bladder; in the skin. As the disease extends, deeper tissues are involved; for instance, the bones of the upper jaw: it rarely occurs in internal organs. It appears either as a nodule which ulcerates; or starts as a crack or fissure, which develops into a foul ulcer, with *hard* edges and base, extending beyond the limits of the sore, and produced by the infiltration of the tissues by the epithelial cells and the cornification or hardening of the older ones. In some the epithelioma does not much affect the deeper structures, but sprouts outwards, forming the so-called "cauliflower excrescences." The consistence is firm, and the section presents a greyish white granular surface, intersected with fibrous lines, and yielding a scanty juice on scraping.

3. *Cylindrical-celled or Columnar-celled, or Adenoid Carcinoma*, is derived from the columnar epithelium, covering surfaces or lining glands or tubules. In structure it resembles tubular crypts when growing slowly, but if advancing rapidly assumes the appearance of irregular cavities, covered with ill-formed epithelium. The stroma may be scanty and delicate or plentiful and coarsely fibrillated; the alveoli are lined with the columnar epithelial cells, but not filled. The tumour soon ulcerates, and bleeds copiously; it has a villous surface.

Seats.—The rectum, intestines, uterus, antrum, sinuses of the nose, bladder, stomach, and the ducts of glands. It is liable to colloid degeneration. Liver is frequently secondarily affected, the tumours retaining the same characters as the primary growth.

Characters of Carcinomata.—Scirrhus and encephaloid are highly malignant, extend peripherally by infiltration, reproduce themselves in the neighbouring lymphatic glands, owing to the lymphatics communicating with the alveolar spaces, and affect internal organs, though more

slowly than some of the sarcomata. The encephaloid variety is the most malignant and most easily disseminated. The secondary growths generally assume the same character as the primary, but encephaloid is common after scirrhus. Epithelioma is the least malignant, slowly affecting the lymphatic glands, and rarely giving rise to formations in internal organs.

Treatment.—Excision by the knife, destruction by caustics or electrolysis, removal by ligatures or *écraseur*. The best internal remedy appears to be large doses of arsenic as a palliative.

Tumours of the higher types of tissues include myomata, neuromata, and angiomas.

Myoma, or Muscle Tissue Tumours, consists usually of unstriated muscular fibres (leiomyoma), very rarely of striated muscular tissue (rhabdo-myoma), combined with this is more or less connective tissue, forming the capsule, and containing a few blood vessels.

Seats.—Uterus, prostate, œsophagus, stomach and intestines. It may undergo calcification, hæmorrhage, and mucoid or fatty degeneration with the formation of cysts; it is harmless.

Treatment.—If required, removal.

Neuroma consists of white nerve fibres; it is rarely met with, though enlargement of the neurilemma of a nerve is common.

Seats.—In the divided end of nerves in cicatrices left after amputations. It is harmless, and usually of small size.

Treatment.—Extirpation by the knife.

Angioma, or Blood Vessel Tumour (*vide* chap. xix.).

Cysts.—A cyst is a cavity containing a fluid, or semi-solid contents, and enveloped by a capsule.

Cysts may originate: 1. By the formation and accumulation of secretions in

cavities already existing. 2. Extravasation of blood. 3. By new formation.

In the first class may be placed: (α) Retention cysts from accumulation of the secretion, owing to obliteration of the excretory duct, viz.: sebaceous, mucous, atheromatous, ranula, encysted hydrocele, lacteal, renal, etc. (β) Exudation cysts from increased secretion in cavities unsupplied with ducts, as bursæ, ganglion, hydrocele, simple ovarian cysts, cystic goitre, etc. In the second class, extravasation cysts, due to accumulation of blood in a cavity or solid tissue, as hæmatocele, etc. In the third class, parenchymatous cysts, or those of independent origin, are: (α) Mucoid or colloid degeneration, of a part forming a cavity, as seen in various new growths. (β) Accumulation of fluid in the meshes of connective tissue. (γ) Cysts formed round foreign bodies, as hydatid cysts. (δ) Congenital, as dermoid cysts.

Sebaceous cysts are common on the face and scalp, and are known by their situation, adherence to skin, rounded form, softness, and ramification of the vessels on the surface. They contain inspissated sebaceous matter, with a highly offensive, sickly odour. They are often present in large numbers, and may grow to a large size, or become inflamed, and be mistaken for an abscess.

Treatment.—Transfix and divide the whole cyst freely, squeeze out the contents, then seize the cyst wall with strong forceps and drag it out, whilst the skin is held with the finger nail, or another pair of forceps. If small, divide the skin only and turn out the bag with the handle of the knife without opening it. Cysts of the back or scalp, if the patient is in bad health, or exposes himself after operation, may be followed by cellulitis. Suppurating cysts must be treated like an abscess.

SECTION IV.

WOUNDS AND ALLIED INJURIES.

CHAPTER X.

CONTUSIONS.—WOUNDS.

CONTUSION is the term applied to laceration of the subcutaneous tissues without division of the skin; it is usually caused by a blow, with a blunt weapon, a fall, or by violent compression. Extravasation of blood, mostly from the veins, always ensues. Bruising easily occurs in fat persons, debilitated subjects, and in individuals suffering from scurvy or the hæmorrhagic diathesis.

There are four degrees of contusion.

1. When the skin and subcutaneous fascia are alone affected, causing a bruise or ecchymosis. 2. The cellular tissue is here implicated, and there is extravasation of blood into it, producing a hæmatoma. 3. The injury extends to the soft parts, leading to sloughing, suppuration, gangrene, or profuse hæmorrhage. 4. In addition to the preceding, the bones are contused.

Symptoms.—Shock, pain, swelling, and discolouration. The discolouration is purplish, black, or reddish at first, but in a few days changes to bluish, olive, green, and yellow; if the blood be deep seated, as between the muscles, the bruise may not appear externally for a few days, and often is seen at some distance from the seat of injury.

Diagnosis.—From gangrene a contusion is recognised by the part preserving its temperature and vitality; from an abscess a hæmatoma is distinguished by its history, and in doubtful cases by using a grooved needle or exploring aspirator. It is worthy of notice that contusions are sometimes followed by the growth of tumours.

Treatment.—In the first degree absorption must be induced by cold spirit lotions, as—

℞ Liq. ammon acetat. ʒij
Sp. vin. rec. ʒij
Aq. ad ʒviij. Ft. lotio.

Or liq. plumb. acet. with glycerine, as—

℞ Liq. plumb. acetatis m℥x
Glycerine ʒiv
Ext. opii liquid ʒj
Aq. ad ʒviij. Ft. lotio.

The tinctures of briony and arnica well diluted with water seem advantageous: subsequently carefully applied pressure. On no account must an incision be made into the fluctuating part. In more severe cases cold applications are harmful; absorbent cotton, or lint soaked in carbolic acid, with a well-applied bandage, are the best measures to adopt. Should signs of suppuration occur, free incisions must be made and the cavity well irrigated with carbolic acid solution, hydrate of choral dissolved in warm water, or any good antiseptic; a drainage tube must be inserted and the wound treated in any suitable manner. When the soft and hard parts are damaged medicated poultices to separate the sloughs: subsequently the granulating surfaces are treated as an ulcer.

Wounds.—A wound is a solution of continuity on the surface of the body or a mucous membrane, suddenly caused by anything which cuts or tears. Wounds are classified into: 1. Incised; 2. Lacerated; 3. Contused; 4. Punctured; 5. Poisoned; 6. Gun-shot.

Incised Wounds are those made by a sharp cutting instrument, their length being well proportioned to their depth, and the tissues evenly divided. They are followed by, (a) pain of a cutting, burning, or smarting character; (b) hæmorrhage arterial, venous, or capillary; (c) gaping of their sides from the elasticity of the tissues implicated, muscular contraction, and weight of the parts.

Contused and Lacerated Wounds.—

These are accompanied by tearing and bruising of their lips, this being due to the nature of the force which occasions them: they are usually inflicted by blunt instruments. Their edges are irregular and jagged, with less gaping and hæmorrhage than occurs in incised wounds; around them is an area of ecchymosis and contusion, so there is a great liability for sloughing to ensue not only at the surface but in the circumjacent parts under the skin. A contused wound when covering a bony surface may resemble an incised wound, owing to the violence which produces the lesion bringing the soft parts in contact with the osseous surface beneath: examples of this are often seen on the face and head from injuries as the blow of a fist, a kick in the vulva will cause a similar appearance from the parts being driven against the pubic arch. These wounds are apt to be followed by traumatic gangrene, which is of the moist variety and tends to advance rapidly without attempting to form a line of demarcation. Other sequelæ are erysipelas, pyæmia, and tetanus. Secondary hæmorrhage is a frequent occurrence. These wounds unite by second intention.

Punctured Wounds are those in which the depth is great in proportion to the length. They are occasioned by narrow, sharp, or blunt pointed instruments, and are very dangerous from the risk of some internal organ or large blood vessel receiving injury, their occasioning extensive inflammation and widely diffused suppuration, and the inadequate opening for the escape of inflammatory products.

Repair of Wounds.—1. By first intention or plastic adhesion. The hæmorrhage having ceased there will be a thin layer of coagulated blood between the cut surfaces. The first step is (a) union by plastic lymph. Infiltration of leucocytes takes place into the surrounding tissues and the clot: a layer of fibrin entangling blood corpuscles glazes the sides of the wound, which being brought together are fixed by fresh layers of fibrin (plastic or coagulable lymph): in the meantime the stratum of coagulated blood liquefies and is absorbed. This is accompanied by slight inflammation of the part, termed

constructive, and limited to the borders of the wound; the connective tissue becoming swollen and its fibres less distinct. Then the normal calibre of the vessels is restored, a part of the leucocytes undergoes fatty degeneration, and is absorbed by the capillaries; whilst part remains and assists in the permanent cicatrisation of the wound. The next step is—(b) Provisional union by cellular neoplasm. The lymph between the sides now becomes vascular from the adjacent vessels sending off loops on either side, invading the connecting medium and joining midway; this proceeds to such an extent that the tract is more freely supplied by blood vessels than the parts in juxtaposition. At the same time the leucocytes elongate. Third step is—(c) The cicatrisation of the wound by filamentary connective tissue. The leucocytes become organised into connective tissue corpuscles when the intercellular substance is converted into fine fibrils, which possess the power of contracting. Finally, the abundant new vessels at site of wound become obliterated.

2. Scabbing, or union under a scab of blood, etc., which prevents the admission of air. Effusion of lymph ensues on the surface under the scab, but this is only slight in amount. A layer of epithelium is formed under this protection, and then the scab becomes loose, and falls off.

3. Granulation, or union by second intention (*vide* chap. iii.).

4. Secondary adhesion, or healing by third intention, by the growing together of two granulating surfaces placed in immediate contact, this is accomplished by fibrinous exudation.

Constitutional Affections after Injury.

—1. Shock. 2. Traumatic fever. 3. Traumatic delirium. 4. Erysipelas (*vide* chap. vii.). 5. Pyæmia and septicæmia (*vide* chap. v.). 6. Tetanus (*vide* chap. xxii.). 7. Hospital gangrene (*vide* chap. vi.).

1. Shock is that state of general depression produced by the effect on the central nervous system of a violent excitation of the peripheral nerves and their terminations. It is proportionate to the extent of the injury and importance of the part injured; it is most marked in injuries of the head, abdomen, thorax, testicle, urethra, and fingers; in old persons; in persons suffering from chronic diseases

of the kidneys, liver, etc., in cases of hæmorrhage.

Symptoms.—Pallor, coldness, fainting and trembling, a weak small pulse, often irregular, eyelids half closed, limbs motionless, enfeebled and irregular respiration, temperature lowered, nausea, vomiting, cold sweats, paralysis of sphincters; there may also be suppression of urine.

2. *Traumatic Fever, or Primary Wound Fever*, is the result of absorption of septic matter from the wounded surface. It commences on the second day, or earlier, and continues from two to six days. The temperature varies from 100° Fahr. to 104° Fahr., the rise being rapid, and reaching its maximum on the second, third, or fourth day: the pulse is quick and bounding, with the usual symptoms of the pyrexial state. It terminates, as a rule, by a crisis, but occasionally by lysis, with evening exacerbations.

Inflammatory, or Secondary Fever (*vide* chap. i.).

3. *Traumatic Delirium* arises on the third or fourth day after the occurrence of a wound, occurring in persons addicted to drink. It may be either sthenic or irritative. In the sthenic form there is *prostration with excitement*, the pulse is quick and throbbing, skin hot, cheeks flushed, eyes bright, breathing hurried and irregular, thirst, and high fever. The delirium is of a furious character. In the irritative variety, or traumatic delirium tremens, the pulse is quick, small, and compressible, skin cool and covered with a clammy sweat, cheeks pale, expression anxious; there are also sleeplessness, trembling hands, unsteady look, and trembling tongue. It is of a muttering character, often accompanied by spectral illusions.

Treatment.—In the management of wounds the following rules, formulated by Esmarch, are clear and concise:—

1. Make the wound as dry as possible by arresting all hæmorrhage. 2. By the introduction of deep sutures and elastic pressure externally, prevent cavities forming. 3. Give free exit to all wound secretion. 4. Maintain a thoroughly aseptic condition of the wound, and of everything else in close proximity, directly or indirectly, with it. 5. Employ a dressing by which moderate pressure can be made, and which will absorb all the discharges from the wound. 6. Rest and fixation of the part.

In incised wounds an endeavour must be made to obtain union by the first intention. To *stop the bleeding*.—If this be general, elevation of the part, exposure to the air, pressure by a bandage, hot or cold water, and styptics. If arterial, ligature, torsion, or acupressure, etc. (*vide* chap. xviii.): when venous, attention to the position, pressure, and in some cases, ligature (*vide* chap. xxi.). When the hæmorrhage has ceased, *remove all foreign matters* by pouring one of the following solutions, from an irrigating apparatus, over the part: for this purpose carbolic acid (1 to 20), thymol (1 to 1,000), chloride of zinc (gr. xx to ʒj), tr. iodi (mxx to ʒj), glycerine, methylated spirits, and water in equal parts, or proof spirit, tannin, and glycerine: in the case of large substances they can be picked out with the forceps. The next step is to *adjust the cut surfaces accurately from behind, forwards, and keep them so* by sutures, plasters, and bandages, remembering that in all deep wounds the sutures must be introduced deeply. Sutures are of silver or iron wire, silver-plated copper wire, catgut (carbolised or chromicised), silk-worm gut, silk, or horsehair. The best form of needle to use is Hagedorn's, which is curved on the edge so that it makes an incision through the skin at a right angle to the margin of the wound, a very ingenious needle-holder is used to insert the needle. In certain operations where wire is employed, a tubular needle is of great service. Sutures are used in various manners; *viz.* simple interrupted, in which each stitch is tied as made; continuous, when the suture is continued, without cutting, from one stitch to another,—this is a useful kind in wounds of the face or intestines; harelip, made by transfixing the edges with a pin, and twisting a thread in figure of 8 fashion round the two ends, or an india-rubber ring may be used instead of a thread; quilled suture, in which the thread is passed double, and tied over pieces of quill, or catheter; button sutures are used for wire, the buttons being oval pieces of sheet lead perforated in the centre, and with a projecting wing at each side, the wire is passed through the hole, fastened to the wing, then passed through the wound, and attached to another button in a similar manner. Serrefines are delicate self-retaining forceps, made of wire.

Sutures should be retained as a rule from five to six days, but of course this time will vary with the exigencies of the case. In removing sutures, the wound should be disturbed as little as possible; soft sutures are gently raised with the forceps and cut in one side of the knot close to the skin, and then withdrawn by pulling the knot towards the side on which the suture was cut; wire sutures are divided on both sides of the twist and straightened before withdrawal. In removing the continuous suture each loop is divided and removed separately. Plaster assists sutures in maintaining apposition of the parts; the varieties are resin, elemi, soap, and isinglass. Gross recommends Martin's plaster, consisting of best Para rubber, Burgundy pitch, and balsam of Peru. Collodion, or styptic colloid, is useful for small wounds.

Special Mode of Treating Wounds.—*The Aseptic Dressing, or Lister's Method,* depends on the fact that the fermentation of the discharge of wounds is due to the growth in them of micro-organisms, derived from the exterior of the body, where they are present in air, water, dust, etc. To destroy the germs, or render the soil unfit for their growth, antiseptics are used; the most common is carbolic acid, but others are used, as boric acid, eucalyptus oil, iodoform, salicylic acid, sero-sublimate (corrosive sublimate and serum of the blood), thymol, acetate of alumina, etc.

LIST OF THINGS REQUIRED IN ASEPTIC OPERATIONS.

1. Small dish containing 1 in 20 carbolic lotion, to purify the patient's skin.
2. Small dish containing 1 in 40 carbolic lotion, for the hands and instruments.
3. A large flat dish containing 1 in 20 carbolic lotion, for the instruments to remain in.
4. Small dish containing 1 in 40 carbolic lotion, in which the protective and a piece of carbolised gauze are put to soak. It also contains a large piece of muslin to act as guard.
5. Steam or hand spray, containing 1 in 20 carbolic lotion for the steam, and 1 in 40 for the hand spray.
6. Two large bottles containing solutions of carbolic acid, 1 in 20 and 1 in 40.

7. Towel soaked in 1 in 20 carbolic lotion.

8. Catgut steeped in 1 in 20.

9. Drainage tubes, horse-hair, and silk-worm gut, in 1 in 20 carbolic solution.

10. Stitches, silver wire, carbolised silk, catgut, horse-hair, etc., in 1 in 20 carbolic solution.

11. Protective in 1 in 20 carbolic solution.

12. Carbolic gauze, kept in a tin box until required.

13. A gauze dressing.

14. Elastic bandage.

15. Gauze or calico bandages.

16. Safety pins (Cheyne).

The skin round the wound, and the hands of the operator and assistants, are washed in a solution of carbolic acid (1 in 20). All instruments are immersed in a similar solution. Sponges are washed in 1 in 40 solution. The air is purified by a steam or hand spray containing carbolic acid solution, as before mentioned, and worked during the whole operation and dressing. The dressing consists of carbolic gauze, which is tarlatan impregnated with a mixture of 1 part of carbolic acid, 4 parts of resin, and 4 parts of paraffin. To protect the wound from the irritating effects of the acid, a "protective" is used consisting of a piece of oil silk coated with copal varnish, and outside this with dextrin; it is cut a little larger than the wound, dipped in carbolic solution, and adjusted in place. Carbolic gauze, larger than the protective, and wetted with carbolic solution (1 in 40), is stationed outside; both together forming the deep dressing. All hollows around the wound are filled with carbolic gauze. A regular dressing is then adapted, consisting of eight layers of gauze, beneath the outer layer being a piece of mackintosh cloth, with the india-rubber side nearest the wound; this must overlap the wound considerably in every direction. The dressings are fastened on by bandages, made of carbolic gauze or thin muslin; and the borders of the dressing fixed by an elastic bandage, and, where necessary, with safety pins. If, for any reason, it is necessary to stop the spray during the operation, the wound is covered with a piece of muslin, soaked in carbolic lotion (the guard). To arrest hæmorrhage, ligatures of carbolised catgut, chromic acid catgut, or sulpho-chromic catgut, are used, and the ends cut short, the ligatures

being afterwards absorbed in the tissues. Drainage is important, and achieved by vulcanised india-rubber, threads of catgut, horse-hair, or decalcified bone, which are kept in 1 in 20 solution, and taken out in the spray. Button sutures are used to stitch deep wounds, less deeply silver wire, and superficially catgut, carbolised silk, or horse-hair. The dressing is changed on the day following an operation, and afterwards whenever the discharge soaks through the dressing; it is never kept on longer than seven days without change, which is performed with the same precautions. Such is the aseptic method, an ideally perfect dressing, but requiring great attention to minutiae, much time, and being costly. In country practice, where the dressing cannot be changed often, antiseptic jute in large quantities may be employed, either carbolic, salicylic, or iodoform; or sponges wrung out of carbolic lotions may be applied outside the deep dressing; or cotton wool impregnated with sulphurous acid fumes. If the wound be not fresh it is washed with a 1 in 5 solution of carbolic acid in rectified spirit, and iodoform powder dusted over it, and then dressed as above. In lacerated wounds the surface is well washed with carbolic acid solution, and salicylic cream (salicylic acid and carbolic glycerine) applied, with the above dressing. Wounds and sinuses already suppurating, are scraped with a sharp spoon, and washed with chloride of zinc, gr. xl to ʒj, and dressed as before mentioned.

Precautions.—The skin must not only be well washed with a 1 in 20 solution, but a towel soaked in the same solution is to be placed over the part to be operated on for half an hour. The operator and assistants must thoroughly purify the hands with 1 in 20; especial care being taken of the nails and folds of the skin. The instruments previous to the operation must be placed in solution for some time, care being taken that the handles, teeth, and catches are well covered and exposed to the antiseptic. All instruments must be handed to the operator in the spray. If the surgeon reaches the hand or instrument out of the spray it must be re-purified before being put into the wound, and for this purpose a basin of carbolic acid solution (1 in 40) is placed close to the operator in the line of the spray. A towel soaked in 1 in 20

is placed between the operator and the patient in the line of spray, and all instruments used during the course of the operation are placed on it. If catgut be used for drainage, a skein is tied in the middle with a thread of gut, which is attached to a needle and stitched to the deepest part of the wound. The bundle is then broken up and brought out at different places in 5 or 6 threads. Catgut will not drain pus.

Decalcified Bone Drainage Tubes.—The tibia and femur of the chicken are used, being first scraped, then steeped in hydrochloric acid (1 to 5) until soft. Articulations are snipped off with the scissors, the endosteum and contents raised at one end and pushed through to the other. They are again steeped in the solution until quite soft and pliable, and then kept in carbolic acid and glycerine (1 to 10) for fourteen days; if required for a longer time, chromic acid is added to the solution. Holes are cut with scissors or punched, and the tube threaded with horse-hair before being used.

Open Treatment of Wounds.—The wound being left exposed to the air without any dressing: this method affords very efficient drainage, and is successful, particularly in wounds of the face. The discharges dry up and are concentrated; a condition unfavourable for the multiplication of organisms, a is also the free admission of oxygen.

Moist Dressings: (a) Irrigation.—The wound being left open, but exposed to a constant stream of water or lotion from an irrigator. This plan is of service in gunshot wounds and after amputations, etc. A piece of lint is placed over the place where the liquid falls, and the parts outside this smeared with oil.

(b) Water Dressing.—The wound is covered with a saturated piece of lint, exactly the size, and covered with oil silk overlapping the lint. Water by itself is not a good dressing, but with the addition of an antiseptic is advantageous. The following solutions are to be recommended: Carbolic acid (1 to 20); boracic acid (1 to 50); salicylic acid (1 to 50); thymol (1 to 1,000); tr. iodi (1 to 80); permanganate of potash (1 to 50); chloride of zinc (1 to 60); sulphurous acid, water, and glycerine (equal parts); corrosive sublimate (1 to 1,000); chlorinated soda (1 to 16).

(c) *Furneaux Jordan's Constantly Moist Antiseptic Sponge Dressing*.—A sponge, soft, trimmed, and moistened, large enough to overlap the area of the locality operated on or injured, is put directly over and in contact with the parts. It is kept on with the desired pressure by means of a few neat turns of a thin bandage, or long strips of adhesive plaster. Holes are next cut in the bandage or straps, to give free access to liquids. Every thirty or forty minutes an antiseptic solution, as one of the preceding, is poured through the openings into the sponge by means of a little jug. Fine soft Turkey sponges are the best. The sponge is removed in from three to ten days. This is useful in removal of the breast, tumours, amputations, resections, herniotomy, castration, amputation of the penis, trephining, etc.

(d) *Alcoholic Dressing* in the form of camphorated spirit of wine, used to bathe the raw surfaces, and afterwards applied on lint. Hutchinson washes the wound with pure spirit, and uses thin compresses soaked in 6 parts of absolute alcohol, $\frac{1}{4}$ part of liquor plumbi, and 16 parts of distilled water. The compresses are kept constantly moist.

(e) *Oil Dressing* is better than water. Carbolic acid 1 part, with olive oil 10 parts; or terebene 1 part with olive oil 3 parts; or carbolated camphor (acid carbolic cryst. 9 parts; alcohol 1 part; pulv. camphor 25 parts; olive oil 35 parts).

Dry Dressings: (a) Gamgee's Method.—He uses absorbent cotton and gauze tissue, and brings the edges of the wound carefully together with lint and styptic colloid or tr. of benzoin, employing if necessary metallic sutures. The parts are fixed by millboard splints accurately adapted to secure rest, and equable compression is made by attention to position and bandages. If the parts are tender he uses glycerine between the absorbent dressing and the wound. No water must be applied to the wound, which is dressed as seldom as possible. When drainage tubes are necessary, the outer end of the tube must be left free, by passing it through a hole in the absorbent pad next the body, or between the edges of two pads, and the dressing completed by securing another pad lightly over the outer end of the drainage tube. This latter pad can be changed as often as

necessary without disturbing the deep dressing. In contused or lacerated wounds, iodoform, borax, or bismuth powders may be sprinkled over the wound, and then the absorbent dressing applied. The absorbent cotton or lint may be impregnated with iodoform, boracic, or salicylic acids, etc.

(b) *Cotton Dressing*.—De Graf first sprinkles tannin over the wound, and outside this applies cotton wool. The dressing is left untouched for from four to fourteen days. Guérin washes the wound with carbolic acid or camphorated alcohol, and then applies many layers of cotton batting, containing camphor powder; this is firmly bandaged, covering the limb for a considerable distance above the wound. The dressing is left untouched from twenty-five to thirty days, provided the temperature remains normal.

(c) *Earth Dressing* is recommended by Hewson. The wound is dusted over with pulverised ferruginous clay, forming a layer $\frac{1}{4}$ inch to $1\frac{1}{2}$ inches in thickness. In the Charity Hospital, New York, the wound having been brought into a granulating condition, then grafts are applied, and the whole covered with clay mixed to a paste with oil. This is applied twice a day.

(d) Other substances which may be used are carded oakum or sawdust.

The preceding are the chief ways of dressing wounds, and whatever method is applied, *free drainage is of cardinal importance*, either by Chassaignac's India-rubber tubes, strands of carbolised catgut, silk-worm gut, oakum, or horse-hair; or glass tubes or spiral wire, etc., introduced into the most dependent part of the wound. The first dressing should not be removed for a week, except under special circumstances or particular methods of treatment. The tubes are cut level with the skin, and two threads of carbolised silk fastened to its orifice and tied in a knot, which is fixed by the dressing, and prevents the tube slipping. In most cases it is best to put the tube in the most dependent place, but if Lister's method is used, and this position would expose the wound to the sources of putrefaction, the tube is placed in another part, for instance at the upper angle in hernia.

Rest is essential, and compresses of lint, absorbent cotton, gauze, or spongo

are useful. Wounded limbs should be placed in splints and slung. If union by first intention does not take place, the wound becomes inflamed, and traumatic fever sets in; all sutures must be removed, medicated poultices or warm water dressing being applied, and the wound, which heals by granulation, treated as an ulcer. For unhealthy wounds iodised colloid—styptic colloid 3j, with iodine gr. xx—is useful.

For contused and lacerated wounds the treatment must be as follows:—All foreign bodies must be removed, and the edges of the gap placed as far as possible in contact; it is inadvisable to remove any skin which is adherent. If the contusion is slight, sutures may be used; if more severe, apply absorbent cotton, saturated with terebene 1 part and olive oil 3 parts; pads of the cotton, or carded oakum soaked in hot water; or medicated poultices, or irrigation with warm water to assist the separation of the sloughs. The aseptic treatment is here very useful. *Free drainage is essential, with rest and fixation of the part.* In severe cases amputation is necessary. 1. In avulsion of the limb by machinery, etc. 2. If the soft parts and the bones be extensively damaged. 3. If the bone be bared to a great extent. 4. Implication of a large joint with laceration of the muscles. 5. Severe crushes of the foot. 6. Laceration of a large artery with injury to the muscles and fracture of the bone. 7. In traumatic gangrene. The after treatment of these wounds which heal by second intention is similar to that of an ulcer.

Of punctured wounds.—Arrest the hæmorrhage by pressure from compresses, cold, and if arterial, cutting down on the severed vessel and tying both ends. The aseptic method is of immense value. Although these wounds generally heal by second intention, an effort should always be made to secure adhesive union. The cavity should be injected with some antiseptic and closed with styptic colloid and absorbent cotton, the sides being kept together by pads, etc. If this fail, and suppuration ensues, take care that the matter is not shut in, by the use of drainage tubes, counter incisions, and enlargement of the wound; medicated poultices and afterwards astringent injections will promote the closure of the wound from the bottom like a sinus. In

the case of wounds inflicted by barbed instruments, as fish hooks, crochet needles, and the like, the point should be pushed onward so as to make a counter opening, the barbed head removed with wire nippers, and the shaft can then be easily withdrawn.

General Treatment.—For shock, wine and water, brandy and water, ether, and anionia, if the patient can swallow. If more severe, maintain the heat of the body by blankets, and hot-water bottles; a mustard poultice to epigastrium is of value. Hypodermic injections of ether and digitalis with atropine gr. $\frac{1}{120}$. As patient recovers, opium and digitalis internally with, in some cases, small doses of turpentine. Suppositories of opium and hyoscyamus are useful. Ice to quench the thirst. In cases of shock, where an operation is necessary, the rule is to wait for reaction, or until the patient is sensible of the pain caused by the injury; then administer ether, and operate.

Traumatic and Inflammatory Fever (vide chap. i.).

Traumatic Delirium.—The sthenic form is treated by ice to the head, leeches, purging, and low diet. Opium and small doses of vin. antimon. A straight waistcoat may be necessary. Irritative form, by large doses of opium with hyoscyamus, or chloral hydrate with bromide of potassium, preceded by a purgative. Stimulants in small quantities. If the insomnia be difficult to overcome, Morratt Baker advises that the patient should be chloroformed, and when under the anæsthetic, a hypodermic injection of morphia be administered.

Poisoned Wounds are arranged in three classes. 1. Poisons the products of disease or decomposition in man or beasts, both dead and living. The poison is either the result of chemical decomposition and of the nature of a ptomaine, or an active multiplying micro-organism. 2. Poisons derived from the arachnidans and reptiles. 3. Poisons derived from insects.

In the first class are placed dissection or post-mortem wounds, malignant pustule, fish wounds, rat bites, hydrophobia, etc. In the second, poisoning by spiders, scorpions, tarantula, centipedes, and venomous snakes. In the third, stings of wasps, bees, etc. These wounds are dangerous from the absorption of a virus

into the system, and, when dependent on micro-organisms, from the spreading and multiplication of the poison in the system. They are apt to be followed by septicæmia, local inflammation, cellulitis (*vide* chap. vii.), pustules, boils, lymphangitis, and in case of bites from venomous serpents, speedy death.

Treatment.—Suction by the mouth, a ligature tied tightly round the limb, excision of the part, followed by cauterisation with the red hot iron or pure carbolic acid. In the second and third varieties use aqua ammoniæ to the wound, and brandy and ammonia internally. Arsenic is much used for snake bites. Injection of ammonia into the veins. Bibson's antidote for rattle-snake bites is composed of bromine 3v, hydrarg. perchlor. gr. ij, potass. iod. gr. iv. Dose, ℥x, repeated in twenty minutes. For the various consequences which may ensue, the reader is referred to the different subjects.

Gun-shot Wounds are those inflicted by substances impelled from fire-arms, and are usually punctured, lacerated, and contused. The orifice of entrance is small, circular, inverted, and marked by livid discolouration; that of exit large, jagged, irregular, more elongated and everted; but, if the momentum of the bullet is great, the appearance of the latter wound may be similar to that of entrance. The symptoms are, pain of a numb character at first, but afterwards acutely burning, accompanied by great prostration and shock, with extreme depression of spirits. The bleeding is less than from other injuries, except when a large vessel is cut, which may cause immediate death. These wounds are followed by inflammation, and profuse and extensive suppuration or gangrene. Consecutive hæmorrhage is apt to occur when the sloughs are separating, from the sixth to the twentieth day. The presence of a bullet is ascertained by digital exploration, or the use of a blunt probe twelve inches long, of silver, copper, or lead. Nélaton's probe is of service if the presence of a bullet is doubtful, or the electric probe may be used.

Treatment.—Gross writes: "In the treatment of gun-shot wounds, six indications are presented. 1. To revive the patient, or promote reaction. 2. To arrest hæmorrhage. 3. To ascertain the precise

conditions of the soft parts and bones. 4. To extract the ball, and any foreign matter that may have entered along with it. 5. To remove any loose piece of bone. 6. To circumscribe the resulting inflammation. To relieve the shock, the measures already mentioned are useful. For the arrest of hæmorrhage (*vide* chap. xviii.). To ascertain the conditions of the parts, the finger or probe. For the extraction of bullets or foreign bodies, the part is placed exactly in the same position as when the injury occurred, and Luer's bullet forceps or Coxeter's bullet scoop employed. Inflammation is limited by cold irrigation, ice bags, and the aseptic method if possible, afterwards medicated water-dressing or poultices; free drainage is imperative. When suppuration results, warm applications and antiseptics, with a free exit to all discharges. Consecutive hæmorrhage must be stopped by applying an Esmarch's bandage, enlarging the wound if necessary, and ligaturing the artery above and below the injury; should this not be possible from the state of the parts, or the depth of the wound, ligature of the main artery in its course; this failing, amputation, if wound be situated in a limb, if not, nothing remains but to try pressure with shot, etc. Amputation is required: 1. When a limb is partially or wholly carried off, or disorganised by a so-called wind contusion, owing to the ball striking the skin in a slanting direction and with slight momentum; thus rolling over the cutaneous surface, which is apparently unhurt, but causing serious subcutaneous injury. 2. In compound gun-shot fractures of the lower third of the femur, bones of the leg and foot; in extensive wounds of the lower extremity, except the hip (where amputation has proved exceedingly fatal in gun-shot wounds); in the upper extremity and the hip, excision or the expectant plan of treatment must be preferred. 3. In acute osteomyelitis. 4. Uncontrollable secondary hæmorrhage from an eroded vessel or ruptured traumatic aneurism. 5. If traumatic gangrene has supervened. Amputation may either be performed primarily and preferably before reaction sets in, or secondarily, after the establishment of suppuration.

In gun-shot fractures involving the head and neck of the femur, Dr. Otis, as

a result of the American war, has drawn the following conclusions. Amputation will be proper: 1. When the thigh is torn off, or the upper part of the femur comminuted with great laceration of the soft parts. 2. When a fracture of the head, neck, and trochanter of the femur is complicated with a wound of the femoral vessels. 3. When a gun-shot injury of the hip-joint is complicated by a severe compound fracture of the leg

lower down, or a wound of the knee-joint. 4. When, without any fracture, the vessels are cut off close to the pelvis. 5. When a fracture in the region of the trochanters, is complicated with such a degree of longitudinal fissuring as will render excision improper. Excision is to be performed in all uncomplicated cases of gun-shot wounds of the head or upper extremity of the femur.

CHAPTER XI.

INJURIES CAUSED BY EXCESSIVE HEAT AND COLD.

Burns and Scalds are the phenomena produced by the application of excessive heat to the body. When the exciting agent is a fluid, the injury is termed a scald. According to the depth of tissue affected, burns were classified by Dupuytren into six degrees.

1. Redness and desquamation, the outer layer of the cuticle being alone implicated.

2. Vesication, the cuticle being detached from the true skin in blisters.

3. Destruction of the cuticle and a portion of the cutis vera.

4. Destruction of all the cutis vera, with exposure of the subcutaneous cellular tissue.

5. Destruction of the superficial muscles.

6. Implication of the whole thickness of a limb.

Scalds generally leave the cutaneous hairs unaffected.

Symptoms.—Pain always accompanies a burn, this being more severe in slight burns of the first three degrees, the nerves being entire and their sensitive ends exposed, inflamed, and highly irritable; whilst in deeper burns the nervous terminations are destroyed, and the parts numbed. The healing of a burn takes place by a process of suppuration, ulceration and sloughing similar to that already described. The ulcerated surface is slow in healing on account of its large, florid, exuberant granulations; the cicatricial tissue is *extremely prone to contract*, giving rise to adhesive bands and deformities.

General Symptoms depend rather on the extent of tissue involved than on the depth of the burn, being most

marked in the very young or old, the enfeebled, and after burns on the trunk, especially the abdomen or thorax. They consist of—

1. Depression, lasting for about two days, the patient being collapsed, with cold extremities, shivering and prostration. Death may ensue during this period from internal congestions of the brain, meninges, stomach, intestines, lung, kidneys, pharynx and larynx. In children, convulsions and coma are very grave symptoms. Patients after extensive burns often complain of great desire to pass water, even though the bladder be empty. Fifty per cent of fatal cases occur during this stage.

2. Re-action and pyrexia continuing two weeks. There are the following symptoms: high temperature, a quick pulse, bright eyes, great and almost unendurable thirst, constipation, scanty secretions, vomiting with diarrhoea, and the other phenomena of irritative fever. Death results from gastro-enteritis, ulcer of the stomach, peritonitis, perforating ulcer of the duodenum (about the tenth day after the accident), pneumonia, pleurisy, and bronchitis; there being a great tendency to hyperæmia, and inflammation of important organs, especially the abdominal. Thirty per cent of fatal cases die at this time.

3. Exhaustion from the continued discharge of pus, with probably the supervention of hectic. Death happens from the thoracic organs being attacked with inflammatory affections, and sometimes from pyæmia. Twenty per cent of fatal cases die during this period.

The Prognosis depends on the extent of the burn, its situation, degree,

Amount of collapse and fever. If the injury exceeds more than one-third of the surface of the body, recovery rarely takes place. Unfavourable symptoms after shock are scanty and albuminous urine, dry skin, constipated bowels, delirium and stupors, rapid feeble pulse, vomiting of blood, and a subnormal temperature. Burns are slow in healing, whilst the possibility of gangrene, pyæmia, and the necessity of amputation must be considered before giving an opinion. The largest number of deaths occur in the first twenty-four hours; the next most critical period is from the eighth to the thirteenth day.

Treatment.—For slight burns of the fingers and toes nothing answers better than collodion, collodion and castor oil, or styptic colloid. The two great principles are, to *exclude the air and retain the cuticle*. The clothes must be removed with great gentleness, and where it would not be possible to remove them without stripping off the cuticle, they must be cut with scissors and the adherent portions left on. In burns of the first degree immersion of the part affected, if an extremity, in iced water from two to four hours, followed by acetate of lead, ʒj, to resin ointment ʒj; or if on the trunk, powdered ice made into a paste with fresh lard, provided the injury is of limited extent. In more severe burns the part should be washed by means of an irrigator or syringe, with Tursche's antiseptic fluid (boracic acid 5 parts, salicylic acid 1 part, water 500 parts). To cover the part, subnitrate of bismuth, or iodoform and bismuth, may be thickly dredged over it, and then absorbent cotton wool of a uniform thickness, bandaged with a moderate amount of firmness outside. In removing this dressing all adherent wool must be left, and olive oil used to soften the crusts. In the case of children, flour may be used in the same way without the wool, the dredging being repeated every half hour. An excellent plan, as recommended by Morris, is to place the little patient in a bed of loose bran so that the child is entirely covered with it. Gamgee uses absorbent cotton and gauze tissue covered with glycerinum boracis, terebene, and olive oil in equal parts. Carron oil or linimentum calcis (solution of lime and olive oil equal parts) is much used as a dressing, but in my opinion is a filthy, dirty, and most foul-

smelling application. A much better remedy is a mixture of 2 parts of carbolised linseed oil, one part of aqua calcis, with a little turpentine or juniper oil. Glycerine of starch is sometimes very soothing, particularly in burns of the face. A method to be remembered is the continuous tepid bath, which is of great service in suitable cases. When several degrees of burns are combined, a solution of nitrate of silver (gr. x to ʒj), though it at first increases the pain, will soon give relief. For scalds, liquor sodæ chlorinat. (ʒj to Oj) applied as a lotion, but in cold weather oil should be used instead of water. Bicarbonate of soda in solution or powder is also of use. To remove fætor, powdered wood charcoal may be employed. Blisters may be pricked or left untouched, but *all cuticle must be retained, and the parts dressed as seldom as possible*. When the sloughs are separating the treatment is the same as an ulcer. I have found nothing better than iodoform and vaseline; other applications which may be used are subnitrate of bismuth, iodoform, and vaseline; carbolic oil or lotion; creasote and resin ointment; resin ointment (ʒj) with turpentine (ʒj); solution of ferri sulph. (ʒj to Oj); picked oakum, especially in burns of the hands and feet. As the granulations have a great tendency to be redundant the treatment must not be too stimulating. Nitrate of silver or sulphate of copper applied round the edge of the sore will reduce the granulations, or better the transplantation of cuticle, which has a like effect, and at the same time helps the process of cicatrisation and renders the scar more supple. Pressure by strapping is very efficacious for the same purpose. Limb should be fixed in a splint to prevent contraction of the cicatrix. In burns of the sixth degree amputation should be at once performed; later on, if by the separation of the sloughs a joint be opened and disorganised, or the wound be too large for the granulating process to fill up, and the patient's health is failing, amputation will be called for.

General.—The axioms are: 1. Allay pain. 2. Promote reaction. In the stage of collapse administer stimulants, as hot coffee, spirits, wine, beef tea, milk punch, etc.; if the patient be unable to swallow, inject ether or tincture of digitalis, hypodermically, or brandy by

the rectum. Medicinal stimulants, as ammonia, ether, etc. Apply warmth by hot-water bottles and blankets. To relieve the pain, tr. opii in small doses frequently repeated, chloral, or morphia and atropine subcutaneously, but the latter should be carefully used owing to the tendency to congestion. In children, full doses of tincture of hyoseyamus. For the thirst, milk and soda water, ice, or barley water with a lemon cut up and placed in it. In the stage of reaction, saline purgatives are useful, or pulv. hyd. c. creta, combined with hyoseyamus, a milk diet, and acetate of potash with tincture of digitalis. Should enteritis or pneumonia supervene, counter irritation to the abdomen or chest; but if these parts are involved, as is often the case, mustard poultices must be applied to any available part not touched by the burn. If vomiting and diarrhoea be present, treat as a case of typhoid fever; should uræmic symptoms arise, subcutaneous injections of pilocarpine with tincture of digitalis. In cerebral affections, continued warm bath with bromides; if the warm bath cannot be employed, warm affusions to the head, or clothes wrung out of hot water. In the exhaustive stage, wine, good feeding, change of air, tonics, and a supporting plan of treatment.

Frost-bite.—The effects of extreme cold are, in the first degree, forcible contraction of the small vessels, with anæmia; in the second, the vitality of the part is endangered; it is stiff, numb, pale, and shrunk. In the third, the tissues have lost their vitality, they are deprived of sensation and motion, and are of a bluish white hue; vesication may occur. The extremities, as the nose, ears, fingers and toes, are most liable to be affected.

Constitutional.—Languor, uncontrollable inclination to sleep, passing on to stupor and coma.

Treatment.—The great object is to moderate the reaction, for if this be excessive gangrene will certainly result. The part should be rubbed with snow and afterwards placed in a cold bath, the temperature of which should be gradually raised. As reaction ensues, warm liquids, as coffee, tea, or wine, may be swallowed, or brandy and milk injected into the rectum; the part

should be wrapped in flannels, vigorous friction being applied. Vertical suspension of the limb affected is useful. If inflammation follow, warm lead and opium lotions, or painting the part with tr. iodi. co.; for frost-bitten extremities painting with dilute nitric acid is recommended. If gangrene happen it must be treated according to the usual methods; amputation, if necessary, should be performed as soon as the line of separation is distinct. In persons who appear dead from cold, besides friction with snow and ice in a cold room, artificial respiration must be persistently employed for hours.

Chilblain, Pernio, is a local erythematous congestion of the skin, due to cold.

Causes.—A feeble state of the circulation, often hereditary, and most frequent in women and children. Too suddenly warming a cold part. Sudden changes in the weather, cold climate, etc. Anything which hinders the blood stream, as tight gloves, or boots, etc.

Symptoms.—There are three degrees.

1. Congestion with extreme itching and tenderness on pressure.
2. Vesication.
3. Death of the skin or cellular tissue, with troublesome ulceration.

Chilblains are most common on the extremities, as the hands, feet, ears, etc.

Treatment.—General. The diet should be generous. A glass or two of wine or rum and milk in the morning. Internally, opium and quinine. Patient must be warmly clad and wear flannels. Bedroom must be heated to the same temperature as the sitting-room. Tight-fitting gloves or boots should be prohibited. Warm stockings worn in bed are of service.—Local. In the first degree, stimulating applications, as aconite, opium, and chloroform liniments in equal parts; or tr. cantharid. 2 parts, with lin. sapon. 5 parts; or turpentine and copaiba or olive oil in equal parts; tr. or lin. iodid. with lin. saponis; tr. capsici; camphor dissolved in Eau de Cologne. To relieve the itching, glycerine and belladonna, or lin. belladonnæ, are useful. In the second stage, ung. hydrarg. flav.; ung. hyd. nit. dil.; ung. hydrarg. rub.; iodoform 3 parts and gallic acid 1 part; iodoform ointment or styptic colloid. If gangrenous, Peruvian balsam until the slough separates, and then any of the preceding applications.

SECTION V.

INJURIES AND DISEASES OF BONES AND JOINTS.

CHAPTER XII.

INJURIES TO BONES.

Contusion of the Bone and Periosteum is a common and usually a trivial accident, but at the same time, in enfeebled or debilitated persons, may be followed by periostitis, abscess, caries and necrosis, etc.

Treatment consists in the application of pressure with absorbent cotton and a bandage, fomentations, and leeches.

Bending without fracture may occur in young persons from the effects of a blow or fall, but this is in most cases associated with incomplete fracture of the convex surface. (Green-stick Fracture.)

Fractures.—A fracture is a solution of continuity of a bone, accompanied by more or less laceration of the periosteum and medulla.

Causes.—1. Direct violence applied to the seat of injury.

2. Indirect violence, causing a fracture through the agency of the mechanical force acting at a distance from the locality of the lesion; for example, a fracture of the collar-bone resulting from a fall on the palm of the hand, the bone giving way in its weakest place from the forces applied by the weight of the body on the one end and a resisting substance at the other. Fractures by contre-coup, which have been described, appear to have no existence.

3. By muscular action, as seen in transverse fracture of the patella.

4. Avulsion or Sprain Fracture, which is the tearing away of a small piece of bone by the stress put upon the tendinous or ligamentous connexions with it.

Predisposing.—Situation, some bones being much more exposed than others, as the nasal. Shape, long bones being especially liable to fracture. Age, exercises great influence as to the tendency

of certain bones to be fractured: in children the accident is most frequently met with in the femur, humerus, and clavicle, and two special kinds of injury are met with:—1. Green-stick fracture; 2. Separation of the epiphyses; in adults the bones of the leg, forearm, shaft of the femur, humerus, clavicle, and the ribs; in old persons the neck of the femur, and lower end of the radius, this being due to senile osteoporosis, rendering the bone weak. Sex, men being more often affected than women, from the nature of their occupations. Certain diseases, as syphilis, rickets, scurvy, cancer, locomotor ataxy, insanity, and diseases of the bone, as necrosis, caries, carcinoma, sarcoma, and hydatids.

Categories.—Fractures are classed (*a*) according to their nature, into: 1. *Simple*—Without an open wound communicating with the broken ends of the bone. The latter may be simply divided, or the fragments may be driven into one another and fixed. (Impacted Fracture.)

2. *Compound*, or having a wound leading to the seat of the lesion. This may occur either from the action of the same force which inflicted the fracture, or the penetration of the sharp extremity of one of the fractured surfaces through the skin (primary). At a later period it may result from a depressed fragment giving rise to ulceration of the skin; or the parts being bruised over the seat of the fracture may slough (consecutive).

3. *Separation of the Epiphysis* is only met with in young persons before ossification is completed. It is most prone to occur at the extremities of the humerus and lower ends of the radius and femur. The ossifying end of the long bone, with the layer of connecting cartilage, is detached. The periosteum is stripped off the shaft, and there is great risk of

suppuration. The displacement is often very great, with injury to the nerves and blood vessels. Reduction is very difficult and best effected under an anæsthetic. These fractures are apt to be followed by diminished growth, shortening, deformity, and impairment of movement. Separation of the epiphyses of long bones is not uncommon in infants the subjects of hereditary syphilis, owing to inflammatory changes at the junction of the epiphysis and the shaft; a similar condition is met with in acute rickets or infantile scurvy, from blood being effused under the periosteum and between the epiphysis and the shaft (Barlow).

4. *Complicated*.—The fracture being associated with some severe injury requiring description, as dislocation, injury to joint, laceration of arteries or nerves, wounds of viscera, etc.

5. *Comminuted*.—When the bone is splintered at the seat of fracture.

6. *Incomplete*.—The chief forms of which are the green-stick fracture, in which the bone is partially broken on the convex side, which only occurs in childhood; and the fissured fracture, which is met with in the skull.

All these fractures may be single, double, or treble, etc., in accordance with the bone being broken in one, two, or more places.

(b) With regard to the direction of the line of fracture, these injuries are divided into: 1. Transverse, usually the result of direct violence, occasionally of muscular action. 2. Oblique, from indirect violence. 3. Longitudinal, in the axis of the bone, often happens from bullet wounds, etc., and in the heads of the long bones from a blow. Other varieties now and then present themselves as spiral, T-shaped, stellate, or dentate.

Symptoms.—1. Deformity owing to the original violence, and displacement by the weight of the limb and muscular action; the displacement may be longitudinal, angular, transverse, or rotatory. 2. Shortening. 3. Preternatural mobility on handling. 4. Diminution or loss of voluntary motion. 5. Crepitus, or a dry, coarse, and rough grating sensation, felt, and often heard, on rubbing the rough ends together. 6. Swelling from extravasation of blood, and this is generally conjoined with ecchymosis. 7. Pain at the seat of

fracture. Some of these symptoms may be absent.

Sequelæ.—Traumatic delirium, pyæmia, tetanus, thrombosis, embolism, fat embolism (from the marrow of bone), œdema of the limb, stiffening of adjacent joints, atrophy of the part, development of tumours at the seat of the lesion, necrosis, acute osteo-myelitis, hypostatic congestion of the lungs, retention of urine, paralysis from implication of a nerve in the callus, shortening of the limb.

Diagnosis is made by the symptoms already stated; but when only one bone of a pair is broken, very careful examination for slight inequalities, swelling, and crepitus should be made. Impacted fractures are detected by the displacement, change of shape, pain, shortening, etc. In compound fractures if there be any doubt the surgeon must introduce his finger into the wound. A rule which must always be attended to is, *to examine and compare both limbs, and in doubtful cases give an anæsthetic*.

Mode in which fractures unite.—1. Simple. The extravasated blood is absorbed in about a week or ten days, after causing some irritation, hyperæmia, and inflammation of the periosteum and adjacent vascular structures. These pour out an exudation of a fibrino-plastic nature into the cellular tissue around the fracture, within the medullary canal, and between the bony surfaces, enveloping the seat of fracture in a red, gelatinous mass. New vessels are produced in the lymph at right angles to the axis of the bone, forming a granulation tissue, consisting of cells derived from the blood corpuscles in a bed of firm intercellular material. The new vessels spring from those of the periosteum and bone in the external callus; but, necessarily, only from the bone in the internal. The tendons, connective tissue of muscles, and ligaments continuous with and contiguous to the periosteum, take on a process of parostosis or tendency to the formation of bone-like tissue, which becomes the seat of ossification by the deposit of lime salts from the newly formed vessels into the granulation or indifferent tissue; in other cases this is preceded by the development of this substance into fibrous tissue or fibro-cartilage, which subsequently becomes ossified. Thus is

formed the provisional callus which is external to the fractured surfaces, and internal in the medullary canal; it occupies from three to six weeks in its completion, and is not so firm as compact bone. Ossification commences, as a rule, in one week from the time of fracture. The steps of the process forming the provisional callus may thus be summarised: 1. Absorption of the blood-clot. 2. Effusion of plastic lymph. 3. Formation of new vessels, and conversion of lymph into a granulation tissue. 4. Ossification.

The next stage is the junction of the compact tissue, by the production of the intermediate or definitive callus. The Haversian canals become enlarged by the absorption of their walls (rarefying osteitis), and are filled with new cells in increasing numbers, and penetrated by young vessels; when the ends of the bone are thus softened and united by a granulation tissue, the latter either at once becomes organised into bone, or, by means of an intermediate change, into fibrous tissue. The process is completed by the absorption of the provisional callus, with the re-establishment of the medullary canal, in from six to eight months, and the hardening of the new bone by sclerosing osteitis. The amount of callus depends on the extent of movement and degree of injury, being greater where the co-aptation is least exact. If the ends overlap and join at an angle there is a large amount of callus, and the fractured surface of the bone is rounded off. In children more provisional callus is produced than in adults. In fractures of the ribs and clavicle, provisional callus is always formed, and this is the usual course of events in animals; but if the bones are kept fixed in a good position, provisional callus is exceptional in adults, except at the before mentioned situations; only intermediate callus filling up the space between the fragments, and connecting them together, but not enclosing their extremities.

Compound.—The effused blood becomes converted into a pus and escapes as a discharge. The broken surfaces and the sides of the wound are acutely inflamed, and covered with exudation, into which vascular loops bend from the bone and periosteum, which again give off fresh branches to form granulations which finally coalesce. The external layer of

cells is given off as pus, whilst by the growth of the internal, and their organisation into a granulation or fibrous tissue, with subsequent ossification, the process is completed. There is great variety in the formation of provisional callus, which may be in large quantity or very scanty. Abscess and necrosis are liable to ensue, and the healing is much more prolonged than in simple fracture; the great difference being that in the one case there is suppuration, in the other none.

Dangers are shock, collapse, hæmorrhage, traumatic gangrene, fat embolism, tetanus, and later on hectic fever, phlebitis, and pyæmia.

Treatment of Simple Fractures.—The indications are: (a) Reduce the fractured surfaces into proper position. (b) Maintain them. (c) Check and limit hæmorrhage.

(a) Reduction should always be performed *immediately*; it is affected by counter extension or fixation of the proximal part of a limb, with extension or traction of the distal portion, and co-aptation with the fingers at the seat of the fracture. *Relax the muscles by attention to the proper position*, and then slight force will adjust the fragments. It is very advantageous to place the patient under chloroform. All original curves must be preserved, the limb being carefully compared with its fellow, and the length of the injured member ascertained by careful measurement to equal that of the sound.

(b) To maintain the ends of the bone in position, various appliances are used, as pads of cotton wool, oakum, tow, blanket; bandages, either flannel or calico; splints of wood, wire, gutta percha, leather, poro-plastic, starch, paraffin, plaster of Paris, tripolith, zinc, tin, millboard, glue, dextrine, silicate of soda or potash, gum and chalk, etc.; junks made of lengths of cane sewn into pieces of calico are useful. The weight and pulley is an admirable apparatus. The student must bear in mind—1. The bandage must never be applied under the splint, or gangrene may result. 2. If possible do not cover the seat of the fracture, so that it can easily be inspected. 3. The splint, which must be well padded, should confine the joints above and below the place of injury. 4. If the fracture be situated in a limb, leave the fingers and toes exposed.

(c) Hæmorrhage is controlled by evaporating lotions; if bullæ form, they should be opened, but the cuticle carefully retained.

Plaster of Paris Treatment.—The best way of treating most fractures is by the method described in Gamgee's excellent work, which all students should peruse, "On the Treatment of Wounds and Fractures." "The limb is surrounded with a layer of absorbent tissue, and outside this another layer of the same tissue, previously soaked in plaster of Paris cream, is moulded. This cream is made by sprinkling in water perfectly fresh and powdered plaster of Paris. Stir with a metal spoon, and continue sprinkling the powder until the liquid acquires the consistence of rich cream, or thin batter. The tissue on being pressed into the liquid, very quickly becomes completely saturated. It requires to be lightly squeezed to express redundant cream, and is then fit to be smoothly applied over the layer of dry tissue with which the part has been previously covered. By bandaging with a white, soft, absorbent roller, the plaster covering is moulded accurately, and without constriction." In this way splints may be cut any shape, adapted to any surface, and almost instantly solidified. By cutting strips of the tissue and soaking them in plaster cream, any joint may be immobilised by a plaster and bandage, brace or lattice work. If desired, gum arabic, starch, or dextrine may be added to the plaster cream to delay solidification. Paraffin moulds and splints can be made in the same way, the paraffin being melted in a bowl immersed in boiling water, and absorbent tissue and bandages dipped into it. Splints thus prepared can be kept on hand, and softened by briefly holding them before a fire. Plaster rollers are very useful, and are formed by taking strips of crinoline muslin, and drawing these through the dry plaster of Paris, at the same time rubbing it in with the hand and rolling it in a loose cylinder. Before being applied, these bandages are immersed on end, in a basin of cold water, until bubbles of air cease to rise. During the employment of the plaster roller, the hand of the surgeon is now and then put into water and passed over the bandage to smooth down the plaster. To soften

any plaster apparatus, salt and water is of service.

Accidents during Treatment.—Spasm of the muscles occurs either from the irritation of the fragments, pressure or injury to the nerves, or alteration in the position of the muscles; it is controlled by keeping the parts in position, together with doses of opium, or subcutaneous injection of morphia and sulphate of atropine. Gangrene may arise either from the bandage being too tightly adjusted at first, or subsequently becoming so from extravasation of blood or effusion of inflammatory products; in order to avoid this, the fracture should be examined *the day after reduction*, and should the extremities look cold, blue, œdematous, feel numb, or the patient complain, the apparatus must be removed and applied more loosely. Should gangrene have supervened there is no course left but to amputate above the line of demarcation. Abscesses occasionally arise at the seat of fracture; these are treated by longitudinal incisions, under aseptic precautions, sufficiently deep to evacuate the pus. If any skin slough, leave open places in the apparatus, and treat wound as an ulcer.

Fat embolism is a somewhat rare accident in the treatment of fracture, and consists in the entrance of fat globules into the blood vessels above the seat of fracture. It most frequently occurs in severe compound fractures, where the medullary cavity is much opened, but to some degree occurs in all cases of fracture. The fat emboli are conveyed to the capillaries of the kidney, lung, liver, brain, spinal cord, etc. If the parts be stained with osmic acid, fat is seen in black masses blocking up the capillaries. Symptoms commence in from twenty-four to forty-eight hours after the injury. They are dyspnoea, pallor or blueness of the face, irregularity of the pulse, occasionally hæmoptysis; in severe cases collapse, coma, convulsions, paralysis and death. If recovery ensue the fat is eliminated by the kidney, and may be detected in the urine after the third day.

Treatment.—Intravenous injection of ether, artificial respiration.

Treatment of Complicated Fractures.—

1. Rupture or wound of the chief artery of the limb, with the formation

of diffuse traumatic aneurism, is most common in the ham. It is treated by compression or ligature of the femoral, provided pulsation can be felt in the arteries of the foot; but if this be absent for three days, or gangrene threaten to set in, amputation through the thigh is necessary.

2. Fracture into a joint will modify the treatment with reference to the early use of the limb; if ankylosis seem likely to supervene, fix the joint in the most favourable position, as knee straight, elbow half supinated, etc. Some mobility will usually be lost.

3. Dislocation with fracture. Put up the fracture temporarily, to prevent injury to the soft parts, chloroform the patient, reduce the dislocation, and treat the fracture in the usual manner. If the dislocation has not been reduced at the time of the accident, wait until the broken ends are united, fix the bone in splints, and attempt reduction under chloroform.

Pulmonary and cerebral congestion must be managed on ordinary principles.

Treatment of Compound Fracture.—If the bones protrude they must be replaced by manipulating the limb under chloroform, so as to relax the muscles; should this be unsuccessful, the wound must be enlarged in a longitudinal direction; as a last resource, the projecting ends must be sawn off in an oblique direction, a spatula or piece of wood being interposed between the bone and the soft parts. In compound fractures associated with arterial hæmorrhage, secure artery if possible in the wound, if not, above it. An attempt should invariably be made to convert a compound into a simple fracture by closing the external wound; if small, by metallic sutures and strips of lint, or absorbent cotton tissue soaked in styptic colloid and applied to the wound. If union by first intention be improbable, insert a drainage tube, and bring it out through the sides or back of the apparatus: the limb is surrounded with absorbent tissue, compressed and immobilised. If the wound be large, treat by the aseptic method. Should suppuration ensue, remove all dressings, provide outlets for the pus with free drainage, and use hot fomentations or some antiseptic. Should the part become inflamed, irrigation, cold evaporating lotions and

opiates. In all compound fractures place the patient under the influence of opium for some length of time. Compound fractures into joints must be treated as wounded joints; in large joints amputation is generally necessary; in others, excision; in the ankle and wrist, except in children, the articular surfaces should be removed. If there be much extravasation and tension, free incisions are necessary. The splints should always be bracketed at the wounded seat. Necrosis may occur. If the necrosed portion of bone is of small size it will make its exit externally; but if large, the wound must be enlarged, and sequestrum forceps used to extract it. If the ends of the bone necrose, sequestrotomy is generally necessary.

Amputation is necessary: 1. If the soft parts be much lacerated. 2. Where the bones are greatly shattered about a joint. 3. When large arteries or nerves are divided. 4. In severe compound comminuted fractures of the thigh; in those of the leg and upper extremity resection is preferable. 5. In certain cases of severe hæmorrhage.—Secondarily for: 1. Traumatic gangrene. 2. Failure of the patient's strength, and inability to support the stage of suppuration. 3. Uncontrollable secondary hæmorrhage. After secondary amputation the constitutional treatment must be very supporting.

Treatment of Comminuted Fractures.—In comminuted fractures the treatment of the splinters depends on whether they are primary, that is, completely detached and lodged near the wound; secondary, still adherent by the periosteum or fibrous tissue; or tertiary, which necrose and suppurate subsequently in the course of the suppurative stage. The primary must be removed at once, and the secondary, if very loose, but when fixed it is better to replace them in the axis of the bone, as they will be fastened by callus. The tertiary must be removed as soon as they are loosened.

Re-adjustment of a fractured bone which is improperly set may be performed during the first two or three weeks, by bandaging the misdirected fragments in opposite directions, or by pads, etc. After this time it is necessary to break the callus, tho patient being anæsthetised, but in most cases

so violent a procedure cannot be advised. In old standing cases with great deformity, osteotomy may be performed with aseptic precautions.

Delayed Union depends either on, 1. Constitutional causes. 2. Local causes.

1. Feeble health, after any of the exanthemata, syphilis, phthisis, venereal excess, drunkenness, pregnancy, lactation, insanity, old age, chronic Bright's disease, insufficient food, scurvy, etc.

2. Want of apposition or immobility.

Treatment.—Apply liniment iodi. to skin over the seat of fracture and its vicinity. Put the limb up securely in plaster of Paris, paraffin, or starch, and give tonics, as iron, salts of lime, cod-liver oil, change of air, etc., with a liberal and nutritious diet.

Disunion when the callus is formed, but afterwards softens and is absorbed; this occurs in growing boys and girls from sixteen to nineteen, and in syphilitic individuals.

Treatment.—Food containing lime, eggs, milk, jellies of ivory dust boiled down, phosphate of lime, compound syrup of the phosphate of iron. Tonics and cod-liver oil. Local (*vide Non-Union*).

Non-Union and False Joints.—Causes:

1. Constitutional. 2. Local.—1. Syphilis, scrofula, scurvy, pregnancy, lactation, the presence of cancer, general debility, and excessive use of alcohol. Chronic Bright's disease is occasionally a cause.

2. Paralysis, inflammation of the soft parts, erysipelas, necrosis and loss of bone, disturbances in the circulation from rupture of the nutrient vessel or coagulation of the blood in the veins, fracture at a part of the bone surrounded by tendons, interposition of muscle or tendon between the fragments, the presence of a foreign body, separation of the fragments by muscular action or fluid in a joint, mobility and defective apposition, too early removal of splints. Some bones are more liable than others to this mishap,—the humerus, femur, bones of the leg and forearm, and lower jaw, being the most frequent seats in the order mentioned. Non-union depends on: 1. There being no stronger medium of junction than a loose fibro-cellular tissue. 2. From absorption of the callus (*Disunion*). 3. Callus being transformed into cartilage which fails to ossify. 4. Development of the plastic

lymph into fibrous tissue forming ligamentous bands, but not ossifying. In the first and second conditions the ends of the bone are smooth and rounded off, but somewhat atrophied and often coated with a fibrous tissue. In the fourth the periosteum is often thickened, the medulla closed by fibrous tissue, the ends of the bones are expanded and covered with fibrous, fibro-cartilage, or cartilaginous tissue. The false joint which results may assume a diarthrodial or ginglymoid nature in accordance with the action of the adjacent muscles on the part. In the orbicular variety one end of the bone is rounded off, the other hollowed into a socket covered by firm fibrous tissue, and in some cases by cartilage. In the hinged form the ends are rounded and smooth, and united by dense strong ligaments permitting free lateral motion. A fibrous capsule surrounds these joints, formed of exuded lymph organised into fibrous tissue, or simply due to the neighbouring soft parts. Inside the capsule is often a fluid consisting of serum poured out by the blood vessels. If the ends are much separated, a bursa may form between them, but in this case does not enclose the broken surfaces. In the third, union generally finally results.

Symptoms.—The bones are atrophied, limb pines, loss of power and proper movements, fragments have free motion on each other, and handling one fragment will not disturb the other or cause it to change its position.

Treatment.—Rub the ends firmly together and readjust the fracture in plaster of Paris or starch. Friction, shampooing, blisters over the seat of fracture. Pass a tenotomy knife, introduced subcutaneously, between the ends of the bone, and cut the connecting bands and periosteum, or introduce acupuncture needles; it must be remembered that position of the main vessel is often changed, and it is bound down to seat of the injury, and thus liable to be wounded. Introduction of a seton across the false joint, or a silver wire which must be tightened and made to cut its way out. Drilling through the bones with a steel drill. Exposing the bones, drilling holes, and driving ivory pegs in. Resecting the false joint and treating aseptically. Caustics, as caustic potash, nitric acid, and the actual

cautery, applied to the ends of the bones after exposure.

Bigelow cuts down on the bones, detaches the periosteum for half an inch, resects the ends, and secures them together by strong wire passing through half the thickness of the shaft, finally uniting the periosteal flaps by sutures. The wire is left in from two to six months. In an old woman, aged seventy-nine, on whom I performed this operation for a compound fracture of the tibia and fibula, with rupture of the anterior tibial artery, perfect union was obtained in three months. Paneoast passes a gimlet-shaped drill between the fragments, and then, turning the instrument to an oblique position, makes it pass through one fragment, across the intermediate substance, and buries it well into the other fragment, pinning the ends together. The gimlet is left in situ until union is well advanced. Agnew clearly sums up the treatment thus: 1. In the treatment of an ununited fracture of any bone, always begin with the simplest and least dangerous of those measures which have ordinarily proved most successful, and advance, if necessary, to those the employment of which involves great danger. In conformity with this rule, forcible manual friction, conjoined with immobilisation, should precede all other plans, especially in recent forms of non-union; next in order would come the use of mechanical appliances or apparatus, by which passive friction of the bone can be maintained. Following manual and instrumental friction, the use of the subcutaneous drill and its modifications will be next indicated, and last, resection with its various modifications. 2. In ununited fracture of the femur, the dangers attending either the employment of the seton or a resort to resection are so great that these methods should be entirely discarded from the surgical resources applicable to the condition under consideration. 3. In instances of ununited fracture where it is deemed proper to employ the seton, the latter should not be allowed to remain longer than seven to ten days.

Constitutional is very important, and is the same as for delayed union. Mercury, even in non-syphilitic cases, is often of great value. It is important that the patient should get about as

early as possible with the aid of crutches. The induced and continuous currents applied to the spine, and also to the limb, are a help.

Particular Fractures.—*Fractures of the Upper Limb.*—Phalanges are rarely fractured, owing to shortness and mobility; if a fracture occur, it is recognised by the displacement, crepitus, and loss of grasping power.

Treatment consists in bandaging the injured finger to a wooden, leather, or pasteboard splint; this must reach to the palm, and be well padded to accommodate itself to the curve of the finger. When the fracture has united, the joint must be bent gradually, to prevent stiffness. If more than one be injured, or the fracture be compound, the splint must be prolonged to the forearm, and be divided to correspond with the fingers. Gangee writes: "Fractures of the fingers are better treated with gummed paper than by other means. In cases of emergency, and in the absence of other materials, many other fractures can be treated with splints made of layers of any paper gummed or pasted together, in sufficient number and thickness to secure the desired strength. Half a sheet of note-paper makes a very good finger splint; gum it on one side, and fold to the width of the finger, over and over, until the half-sheet is exhausted, then place it under the finger and mould it accurately. If the splint thus moulded be taken off carefully, and dried before the fire, or placed in the kitchen oven on a plate for a few minutes, the mould becomes hard and strong, and can be bandaged to the finger over lint or cotton wool."

Metacarpus and Carpus are seldom broken except by great force; in all the instances I have seen there has been little displacement, but considerable pain and crepitus, conjoined with some swelling and exceptional mobility of the corresponding digit. In some cases the soft parts are much injured.

Treatment is by means of a gutta percha or leather splint, or by a round ball placed in the hollow of the hand, and secured with a bandage.

Radius may be fractured at its lower end, which is by far the most usual locality; in the shaft; or, rarely, at the neck.

Fracture of the Lower Extremity
(Colles' Fracture).

Causes.—Usually from falls on the palm of the hand; more rarely, from direct violence or falls on the back. It is seldom met with until at or after the middle period of life, and is most frequent in women. The bone at this time is the seat of rarefying osteitis.

Situation.—At any point within two inches of the wrist joint, perhaps most commonly at about three-quarters of an inch above the wrist, but in some cases merely a thin plate of bone is broken off the lower end.

Varieties.—1. Simple transverse; 2. Comminuted; 3. Impacted.

Symptoms.—When simple, the displacement is slight, the lower end of the radius with the carpus being carried backwards, and the shaft projecting in front. There will be loss of the power of supination and pronation, severe pain, and crepitus, produced by drawing down the hand and rotating it. If comminuted or impacted, the displacement is well-marked and characteristic. The lower fragment projects at the back, and is rotated on its transverse axis, looking somewhat upwards, and also pushed laterally, so that the styloid process is impelled outwards; there is a falling of the wrist from the ulnar side, which appears lengthened, and the styloid process of the ulna is unduly prominent. The pain is severe, and increased by all attempts at rotation; the hand is powerless, and the movements of pronation and supination lost. When impacted, a condition which is met with in 50 per cent. of these cases, there is no crepitus, but great deformity. According to Clement Lucas, in addition to the fracture of the radius, there is usually either a fracture of the styloid process of the ulna, or a tear of the internal lateral ligament of the wrist-joint, and, in addition, frequently a rupture of the triangular fibro-cartilage. The displacement of the upper fragment on the palmar surface, just above the wrist, is due to the pronator teres and quadratus; of the lower portion to impaction, when present, the posterior part of the upper fragment being driven into the cancellous structure of the lower; in other cases to the action of the radial extensors, extensors of the thumb, and supinator longus. In a rare form of

fracture, described by R. W. Smith, occasioned by falls on the back of the hand, the inferior fragment is placed forwards. In some cases fracture of the lower end of the ulna is conjoined with Colles' fracture.

Diagnosis is made by the peculiar displacement, reduction of the deformity by traction, and its recurrence when this is withdrawn, crepitus, and the styloid process following the movements of the hand.

Treatment.—Reduce the fracture and remove the deformity by traction on the hand whilst the hand is supinated and adducted, combined with pressure on the fragments. In difficult cases apply extension with the hand, in the hyper-extended position, to relax the periosteum. If the fracture be impacted, as is so often the case, reduction is often impossible, and considerable deformity is invariably left, in spite of the best efforts of the surgeon. The patient should be informed of this, as otherwise the medical man will be blamed for what could not possibly be avoided. It is always well, at the end of the first week, to re-adjust the broken surfaces, as swelling has then diminished and any splinters are loosened. Many splints are used, but as good a one as any is Carr's American splint. Some surgeons prefer the pistol-shaped splint, or a straight anterior splint to the middle of the palm, and a back splint to the dorsum of the wrist, or Gordon's splint. Spence used an anterior Gooch's splint, and a posterior angular of card-board; the anterior reaches from the elbow to the wrist, and is as broad as the forearm, and slightly cut away at the upper part opposite the elbow joint; the lower end has its outer angle removed for an inch, forming a notch over the radius; the posterior splint extends to the distal end of the metacarpus. Any of these splints should be kept on for three weeks, and then shortened, or a gutta-percha gauntlet applied to allow the fingers to move. Passive motion of the fingers, and gradually of the wrist, should be used; it will be three to six months before the patient will have a good use of the hand and fingers, as synovitis and thecitis are apt to cause adhesion of tendons. Stiffness may result from the fracture extending into the joint, or from comminution or crushing of the substance of either fragment.

Fractures of the Shaft of one or both bones of the forearm are of common occurrence, and may arise from a blow, the passage of a heavy body over the forearm, or by a fall on the hand; in the latter case the bones are not necessarily fractured at the same level, the radius sometimes giving way at a higher point than the ulna. The most common seat is at or above the union of the lower and middle thirds.

Symptoms.—Shortening, loss of pronation and supination, angular displacement and crepitus. If only one bone be broken a more careful examination is necessary; in the case of the radius its head is motionless when the surgeon pronates and supinates the hand. In several cases in children I have met with a green-stick fracture of the ulna, with marked angular deformity, but no crepitus. If the fracture be situated between the insertion of the biceps and that of the pronator teres, the upper fragment will be strongly supinated by the biceps and supinator brevis, and the lower pronated; if this displacement be not rectified it will result in the total loss of the power of supination.

Treatment.—If only one bone be broken, Carr's splint. When both are fractured below the middle of the forearm, an external wooden splint reaching from the external condyle to the metacarpus, and an internal from below the internal condyle to the wrist. These must be broader than the forearm, and applied to the part with the thumb upwards; a pad may be applied between the bones, and the limb slung from the elbow to the wrist. Another plan is to place a layer of absorbent cotton round the limb and a millboard splint on the outer and one on the inner side with a bandage, strengthened if necessary by starch, gum, or glue; the splints should reach the ends of the fingers. If fractured above the middle, the hand must be fixed in a position of supination on a rectangular splint applied behind the limb and a short anterior splint to the forearm. Scott's method consists in placing the forearm supine, and applying a posterior angular splint reaching beyond the fingers; extension is made from the wrist by adhesive plaster, with elastic bands; counter extension is made from above. All splints should be worn three weeks and then passive motion is to be used,

and the splint left off altogether in four weeks, the arm being simply supported by a sling.

Fracture of the Olecranon.—Causes: Falls on the elbow or blows, as a rare event from muscular action. It is most common in middle life.

Symptoms will vary according to whether the tough ligamentous expansion of the triceps is or is not torn through. In the latter case the fragment suffers no displacement, and the fracture is recognised by the lateral mobility, pain, swelling, and crepitus. In the former the triceps draws the detached fragment considerably upwards. The accident is recognised by: 1. A depression at the back of the joint. 2. The forearm is semi-flexed from the action of the brachialis anticus and biceps, and the power of extending the forearm is lost. 3. Crepitus can be recognised by the surgeon making extension. 4. An unnatural, hard swelling at the under and back part of the humerus, from the olecranon being drawn up, sometimes half an inch above the joint, and sometimes two inches from the lower fragment, but the interval is always much increased on bending the arm. This swelling is easily movable from side to side, but only brought down with difficulty. 5. Bulging of the triceps above the swelling. 6. There is considerable effusion into the joint. These fractures join by ligamentous union.

Treatment.—Keep the limb in a slightly flexed position and bring the upper fragment down by a strip of plaster applied in a figure of 8 over a pad of lint placed above the fragment, bandage the forearm and carry the roller up in figures of 8 over the pad, then bandage the arm, and apply an anterior straight splint, or a Hamilton's notched splint may be used; in four or five weeks use passive motion. If the fragments be widely separated, from the ligamentous union yielding, and the arm be useless, under strict aseptic precautions the joint can be opened and the fragments sutured.

Fractures of the Humerus.—Near the elbow joint three varieties are met with. 1. Separation of the lower epiphysis of the humerus. 2. Transverse fracture above the condyles. 3. Fracture of either condyle.

1. *Separation of the Epiphysis.*—The nucleus appears in the capitellum at the

third year, in the trochlea at the eleventh; the epiphysis unites at the sixteenth or seventeenth year. The whole of the epiphysial line is included within the synovial membrane. This injury is met with in children and young adults; the capitellum, trochlea, and condyles, together with the bones of the forearm, are carried backwards. Exceptionally the capitellum and trochlea alone are separated, the condyles remaining *in situ* (Infracondylod separation of the epiphysis). There is no crepitus, but the triceps muscle is arched, and the sharp extremity of the shaft of the humerus can always be felt and often seen in front of the joint. The accident is distinguished from a dislocation by the readiness with which it is replaced on extension, and again occurs, the absence of the hollow of the sigmoid notch, movements of flexion, pronation and supination being easy, and the length from the internal condyle to the styloid process being unaltered, the condyles retaining their relation to the olecranon. In fracture when the forearm is semiflexed and the arm fixed, there is *lateral motion* at the elbow joint, but *not* in dislocation.

2. *Transverse fracture* is characterised by displacement backwards of the forearm and lower fragment, forming a projection behind, and due to the action of the biceps, brachialis anticus and triceps muscles; but if the line of fracture be obliquely downwards and backwards, the lower fragment occupies a position in front of the upper. Pain and crepitus. The upper fragment forms an irregular prominence in front of the joint, pushing forwards the brachialis anticus. From dislocation it is distinguished by the symptoms of the preceding form, with the addition of crepitus. There is shortening on measuring from the acromion to the internal condyle, and with the very best treatment, some diminution in length is generally left.

3. *Condyles*, either the external or the internal, may be split off, occasioning considerable pain and swelling, with but slight displacement. A larger or smaller portion of the internal condyle (epicondyle) may be broken off without implicating the joint. Crepitus may be obtained by rotating the radius, if the external condyle be affected, or by flexion and pronation of the forearm when the

internal condyle is at fault. If the inner condyle alone is detached the ulna projects backwards, but this projection disappears when the limb is extended. The condyle forms a swelling at the back of the joint, and if the forearm be extended the humerus advances in front of the ulna. When the outer is disengaged a swelling is perceived at the outer and back part of the joint, the hand is supine, the forearm semiflexed and movements difficult. In fractures of the external condyle, branches of the musculospiral, and in fractures of the internal, the ulnar nerve may be injured, giving rise to paralysis. A rare form of fracture is a V- or T-shaped fracture splitting off both condyles and running into the joint; in this case there is more marked deformity, with widening of the joint, the radius and ulna project backwards, there is a hollow at the bend of the arm, and the distance from the elbow to the wrist is diminished. All fractures near the elbow are liable to be attended with inflammation of the joint.

Treatment. Separation of the epiphysis is best managed by a hollow rectangular back-splint, and an anterior hinged angular splint. For the other fractures, two lateral, hollowed, angular splints, one internal from the axilla to the wrist, the other external from the deltoid to the wrist; they should be hinged, and the angle changed at the end of a month, with the application of passive motion daily. In cases where the displacement is not rectified with facility, the splints should be applied anteriorly and posteriorly, or a poroplastic or gutta-percha splint may be used.

Shaft of the Humerus.—Fractures in this position are, as a rule, oblique downwards and outwards, and are caused by any kind of external violence, and occasionally by muscular action.

Symptoms are increased mobility, shortening, crepitus, and displacement, which varies according to the seat of fracture; when broken below the insertion of the deltoid, that muscle abducts the upper fragment, and the lower one is to its inner side; if the bone be fractured above the insertion of the deltoid, and below those of the pectoralis major, latissimus dorsi and teres major, the lower fragment is abducted, and the upper adducted to its inner side; if the break occur through the lower third, the

inferior part is apt to slip behind the upper one and be drawn up by the biceps and the triceps. These fractures are easily recognised. Paralysis from injury to the musculo-spiral nerve, or implication of it in the callus may supervene, or compression of the brachial artery by one of the fragments which may result in gangrene.

Treatment.—By four straight hollow splints: one external from the acromion to the external condyle; a second internal from the armpit to the internal condyle; a third shorter one behind the arm; and a fourth very short in front; with these a sling should be worn, allowing the elbow to hang free. In difficult cases an L-shaped splint long enough to extend from the wrist to above the shoulder. This apparatus must be worn for three weeks, when passive motion may be applied, and the splints discontinued in five weeks.

Upper end of the Humerus.—There are six kinds of fractures which occur at this situation:—1. Intracapsular; 2. Impacted intracapsular; 3. Fracture at the line of junction of the epiphysis; 4. Extracapsular; 5. Impacted extracapsular; 6. Fracture of the great tuberosity.

1. Intracapsular fracture results from severe falls or blows on the shoulder. The symptoms are some loss of motion of the shoulder, considerable pain, swelling and deformity. The upper end of the lower fragment can be detected as a rough substance at the inner side of the joint. There is shortening about three-quarters of an inch, on measuring from the acromion to the olecranon; and by extension and rotation crepitus can be obtained.

2. Impacted intracapsular is due to the upper fragment penetrating the lower. Crepitus is slight or absent, but should the tuberosity be also broken, is readily obtained. The line of the shaft is directed towards the coracoid process; and an irregular bony swelling is present here. The elbow projects slightly from the side, acromion is more prominent than natural, and the shoulder has somewhat lost its rounded form. Motion is impaired, and there is shortening one-third of an inch.

3. Fracture at the line of junction of the epiphysis. The line of junction between the epiphysis and shaft runs

from the inner incurvation of the groove, forming the anatomical neck, outwards and downwards, to a point a little below the lowest projection of the tuberosities. Only a small part of the epiphysal line lies within the synovial membrane. The nucleus appears at second year, epiphysis unites at the twentieth. This injury occurs in youth and early manhood; the upper fragment keeps its place in the glenoid cavity, the lower is drawn inwards by the muscles passing from the chest to the arm, and projects under the coracoid process. The symptoms are alteration in the axis of the limb which passes upwards, inwards, and forwards; elbow does not project from the side; head of the bone can be felt in the glenoid cavity, but does not rotate with the shaft. Upper end of the lower fragment *feels round, smooth, and slightly convex*; on pressing this outwards and the elbows inwards, during extension and counter extension, the deformity is reduced, and indistinct crepitus obtained. The displacement, however, readily recurs; there is neither shortening nor lengthening of the limb.

4. Extracapsular through the surgical neck below the tuberosities, but above the insertion of the pectoralis major, latissimus dorsi, and teres major, occurs from direct violence, as falls and blows on the shoulder. Symptoms are, displacement, the upper fragment being rotated outwards, and abducted by the muscles attached to the tuberosities, whilst the shaft projects in the axilla, being drawn upwards by the deltoid and inwards by the muscles attached to the arm and trunk, pectoralis major, teres major, and latissimus dorsi, and the flexors of the limb. The head does not rotate with the shaft, the limb is useless, and the elbow projects a little from the side. There is flattening some distance below the acromion, crepitus easily produced, and excessive mobility of the lower fragment on extending the arm. Severe pain is present from pressure on the axillary plexus, and shortening three-quarters of an inch. The latter symptom, crepitus, and continuance of the rotundity of the shoulder, together with the displacement, distinguish this accident from dislocation.

5. Impacted extracapsular, the superior fragment being penetrated by the inferior. There are loss of motion,

slight deformity about the joint and upper part of the arm, with occasionally slight crepitus on fixing the head and rotating the elbow. The circumflex nerve may be wounded or included in the callus, giving rise to paralysis of the deltoid.

6. Great tuberosity is fractured from falls and blows on the shoulder, or muscular action, and this is often associated with dislocation forwards. The symptoms are displacement of the tubercle, which is abducted and drawn upwards and under the acromion process by the supraspinatus, infraspinatus, and teres minor, whilst the head of the bone is adducted and drawn upwards by the flexors and adductors of the limb, and lies on the edge of the glenoid cavity. The breadth of the shoulder is much increased, the head of the bone can be felt under the coracoid process, and the tubercle at the outer and back part of the joint with a groove between them; on approximating these fragments, crepitus is obtained. The patient is unable to raise the arm to any considerable extent, or to rotate it outwards, and severe pain will be felt when it is moved. Union is generally ligamentous.

Treatment.—Reduction, if difficult, can often be effected by raising the arm parallel with the head, adjusting the fragments, and bringing the arm down whilst traction is maintained. For all these injuries a gutta-percha cap, or one of poroplastic, reaching from the root of the neck to two inches below the elbow, an inner angular splint of wood or wire, and a spica bandage over the shoulder, and then continued in simple spirals down the arm. A sling should support the hand, the elbow being free, and the arm must be well bandaged to the side a little in front of the medio-lateral line. Gamgee writes, that the arm and axilla are to be well padded with antiseptic cotton and gauze, and over this in various directions strips of moistened millboard are laid diagonally; each strip is fixed by a turn of a bandage. The opposite axilla is padded and the injured shoulder covered with figures of 8. The elbow is fixed at a right angle, with the forearm in the semiprone position, by millboard splints, and the limb fixed by a bandage to the trunk. Erichsen recommends, "A leather splint about two feet long by six inches broad, bent upon

itself in the middle so that one half may be applied lengthwise to the chest, and the other half to the inside of the injured arm, the angle formed by the bend, which should be somewhat obtuse, being well pushed up into the axilla."

Fractures of the Scapula are of rare occurrence, this bone being protected by a large mass of muscle-covering and by its mobility. These accidents are divided into those: 1. Of the acromion; 2. Of the coracoid process; 3. Of the neck; 4. Of the body; 5. Of the inferior angle.

1. Fracture of the acromion process occurs from direct violence, but occasionally from indirect, as falls on the palm of the hand or elbow. The symptoms are dropping and flattening of the shoulder, irregularity on feeling along the spine of the scapula, pain, loss of power to raise the arm; on forcing the arm upwards and rotating it crepitus is obtained, the displacement being rectified, measurement from the sternal end of the clavicle to the point of the shoulder is diminished. Should the tip only be broken the patient cannot elevate the hand to the crown of the head, and the detached portion can be felt; there is no shortening.

Treatment consists in raising the arm by a sling under the elbow, and bandaging it to the side in rather a backward position, with a pad in the axilla apex upwards. Union is generally fibrous or ligamentous.

2. Fracture of coracoid process results from direct violence. The symptoms are crepitus felt on raising the arm outwards, and pressing between the deltoid and pectoralis major, together with difficulty in raising the arm upwards and forwards in consequence of the detachment of the origin of the biceps and coraco-brachialis. Mobility of the fragment can be made out on fixing the scapula and moving the arm backwards and forwards. The fragment is drawn downwards by the biceps and coraco-brachialis, and inwards by the pectoralis minor. Bony union is rarely obtained.

Treatment.—Put the arm in a sling, and fix it to the side with the elbow raised and the forearm flexed.

3. Neck of the scapula may be broken by falls on the shoulder. Fracture of the anatomical neck is never met

with, but that through the surgical neck opposite the notch in the superior costa may occur, but is rare. Symptoms are lengthening of the limb, which hangs loosely by the side, the humerus is unusually moveable; there is a depression beneath the acromion, which projects unduly; on raising the arm and drawing it from the side, the form of the joint is restored, and crepitus may be perceived, but on relaxing the hold the displacement returns. There may be paralysis of the limb and impairment of the circulation from injury to the axillary nerves and vessels. It is to be diagnosed from dislocation, by the mobility, crepitus, forearm hanging loose and straight down, the ease with which the deformity can be rectified and recurs, and the hand being able to touch the opposite shoulder with the elbow close to the side. This accident is apt to be followed by stiffness of the shoulder joint.

Treatment is the same as for intracapsular fracture of the humerus, and must be continued for about three months.

4. Body of the scapula is rarely fractured, and when this injury occurs it is the result of direct violence, as a heavy blow, crush, or fall. The fracture is usually transverse below the spine, but may be longitudinal or radiating; in some cases the spine is broken. The muscles prevent much displacement and render the recognition of the lesion difficult. Mobility and indistinct crepitus is ascertained by grasping the shoulder and upper part of the scapula with one hand and the inferior angle with the other, or by rotating the humerus with the hand spread out over the scapula. In fractures of the spine displacement can be detected.

Treatment.—Support the arm by a sling and bandage it to the side, then place a piece of adhesive plaster on leather over the scapula and clavicle.

5. Inferior angle, may be broken off and displaced forwards by the serratus magnus, teres major, and latissimus dorsi. The angle is felt motionless when the scapula is moved.

Treatment.—Draw the arm inwards and secure it by a bandage round the chest, with a compress on the detached fragment, and the forearm in a sling.

Fracture of the Clavicle is most common in infancy and childhood. Four varieties are met with. 1. Great con-

vexity, usually from indirect violence, as falls on the hands or shoulder, but may be from direct; 2. Between the coraco-clavicular ligaments; 3. External to the insertion of the trapezoid ligament: both these injuries arise from direct violence; 4. Internal to the rhomboid ligament (very rare).

The symptoms vary according to the seat; when broken between the coraco-clavicular ligaments there is no displacement, but pain on pressure, crepitus on moving the shoulders, and irregularity on palpation: when fractured external to the trapezoid ligament, the articular surface of the scapular fragment is turned forwards and inwards, also somewhat downwards at a right angle with the rest of the bone; this results from the weight of the arm and the action of the pectoralis minor and rhomboidei muscles rotating the scapula, and the rhomboidei major and minor, with other muscles depressing and rotating forwards the anterior angle of the scapula. In fracture of the middle of the bone—much the most common situation—the inner fragment over which the skin is stretched remains fixed by the sterno-mastoid and pectoralis major, whilst the outer is drawn downwards by the weight of the arm, and inwards towards the middle line, under the fixed portion, by the muscles passing from the trunk to the arm, namely, the pectoralis major and minor, latissimus dorsi, teres major, and subclavius; these also draw the shoulder and outer end of the fragment forwards. The deformity is generally apparent to the eye and readily detected by the finger. There is loss of power in the limb, the patient supporting the injured arm with its fellow and leaning his head to the affected side. Crepitus can be obtained by raising and rotating the arm, with the elbow pressed to the side. In children the symptoms are less marked, pain, swelling, and slight indistinct crepitus on movement. The accident is often a green-stick fracture.

Complications which may be present are wound or injury of the nerves of the brachial plexus, or one of the large blood vessels. When broken internal to the rhomboid ligament, the outer fragment is displaced forwards by the subclavius and pectoralis major, but remains at the same level as the inner.

Treatment.—In the majority of cases

under the most skilful treatment, some deformity remains although the arm is not impaired in its functions. For the second and third varieties a figure of 8 bandage, with the arm in a sling, is sufficient. For the first, many ways are employed. (a) Raise the shoulder by a pad on the axilla, correcting the inward displacement. Press the elbow well back to remedy the rotation forwards, and bandage it in this position to the side. Lift the whole arm by a sling catching the elbow. The fingers and the hand should be previously bandaged.

(b) When it is particularly desirable to avoid deformity, when the fracture is comminuted or both clavicles are broken, keep the patient on his back on a flat couch for three weeks, with the head alone supported by a cushion and the arm fixed to the side.

(c) Sayre's method consists in using two strips of broad adhesive plaster; one surrounding the upper part of the arm on the injured side and running thence across the back and round the chest; the other beginning in front of the sound shoulder, passing over it obliquely across the back to the opposite elbow and up again across the front of the chest, embracing the whole forearm to the point where it started. A slit is made in this strip for the elbow.

(d) Gordon's apparatus is useful, composed of a shield secured to the chest by straps round the healthy shoulder, carrying a rod (artificial clavicle) which can be lengthened by a screw, and has at the end a metal splint to embrace the arm.

(e) Fox of Pennsylvania used a padded collar or ring encircling the sound arm at the shoulder, a wedge-shaped pad in the axilla of the affected side fastened by tapes to the collar, and a sling of stout muslin to receive the elbow and extend four inches up the arm, with two broad tapes of linen webbing attached to the upper and lower part of the elbow piece and serving to fasten the sling to the collar.

(f) Bryant recommends that a pad should be placed over the scapula below its spine, and that bone firmly bound to the thorax by means of broad pieces of strapping encircling half the chest from the spine to the sternum; at the same time the arm is supported in a sling and the arm drawn upwards towards the opposite shoulder.

(g) Other methods are Ellis' apparatus. Figure of 8 round the shoulders, or a silk handkerchief passed round each shoulder and firmly tied together. All modes of procedure in which a pad is placed in the axilla are apt to produce congestion of the hand and arm running on to gangrene, so the limb should be carefully watched, particularly noticing the colour of the finger nails and the state of the pulse at the wrist.

Fracture of the Ribs is a very common accident. It may arise from direct violence, by a force applied over a small surface, the part struck being driven inwards and broken; or from indirect violence applied to the two ends, the chest being compressed and the rib bending outwards and snapping. When caused by direct violence the broken surfaces are forced in, the lung and pleura being liable to be injured. Muscular action is a rare cause, as from contraction of the abdominal muscles during labour, or in old persons from coughing. Fracture of the ribs is more common in the male, and in middle-aged or old persons: when occurring in children the fracture is often incomplete. The rib may be broken in two or more places: one, two, three, or even all the ribs may be broken, but multiplicity of fracture is most frequent after indirect violence. The greatest number of ribs I have seen broken at the same time and verified post-mortem is twelve. The first, second, and last two ribs are rarely implicated, the former being protected by the clavicle, and the latter moveable. The lung is more apt to be wounded when the upper ribs are broken. The most frequent site of the lesion is the convexity or near the angle.

Symptoms.—Pain, much increased by respiration, and this act is chiefly abdominal, pressure on the sternum will also add to the pain. Crepitus felt by placing a hand over the injured part and directing the patient to inspire or cough; crepitus is sometimes absent if the periosteum be untorn. Tenderness on pressure is constantly present. Undue mobility can be ascertained by pressure on the ends. Difficulty in breathing with stitch in the side. There is a troublesome, short hacking cough, frequent but suppressed.

Treatment.—A broad bandage round

the chest, or broad strong strapping or plaster of Paris splint applied half round the chest. Displacement can be rectified by compresses over the sternum, to force the broken extremities directly outwards, and directly over the broken ends to push them inwards. Spare diet and complete rest. Opium to relieve the pain. Union as a rule takes place in from thirty to thirty-five days. For the complications which may happen *vide* chap. xxix.

Fractures of the Sternum are rare, especially if unaccompanied by some other injury, as a fracture of the rib or spine. When present it is usually the result of great direct violence, as the passage of a cart wheel over the chest, but may be occasioned by indirect violence, as bending the body forcibly backwards or forwards, and very seldom from muscular action. Fracture may be transverse, oblique, or longitudinal. The seat of the lesion is, as a rule, between the second and third pieces. The symptoms are pain, difficulty in breathing, crepitus, and displacement of the lower fragment forwards. If compound, abscess may form, implicating the anterior mediastinum.

Complications.—Extravasation of blood into the anterior mediastinum; injuries to the pericardium, heart, pleuræ, or lungs; fractures of the ribs or spine.

Treatment.—Rest in bed with a longitudinal pillow between the shoulders, and the pelvis slightly raised. For abscess, free aperture for the pus, by trephining through the bone.

Fractures of the Bones of the Face.—*Nasal Bones* suffer fracture much less frequently than might be supposed from their exposed situation. When the accident occurs it usually follows direct violence, and is recognised by the flattening and obliquity of the nose attending it. The swelling and ecchymosis may render its detection difficult; then these should be subdued before treating the fracture.

Complications.—Severe epistaxis, emphysema, injury to the lachrymal sac, concussion of the brain, fracture of the ethmoid or frontal bone, exfoliations of portions of bone with ozaena, amaurosis, tetanus.

Treatment.—Raise the bone by a pair of polypus forceps introduced into the nostril and opened; then to retain the

fragments in position, if necessary, the nose must be stuffed with a plug of oiled lint, round a quill, perforated laminaria tent, or bit of catheter. Ice or cold-water dressing afterwards. Erichsen recommends a dilatable india-rubber plug; Hamilton uses pledgets of medicated wool attached to a string; Mason advises a wire suture passed transversely through the nose to keep the fracture in position. If deformity remain, digital pressure every day for a couple of hours, or as used by Adams, a pair of smooth-bladed forceps and screw clamp to forcibly adjust the bones in position.

Lower Jaw may be fractured:—1. At the symphysis (rare); 2. Through the body to one side of the symphysis, commonly near the canine tooth; 3. Through the angle; 4. Coronoid process (rare); 5. Neck of the condyle.

Causes.—Direct blows, falls on the chin, gunshot wounds, kicks from a horse, in extracting teeth; occasionally by indirect violence, as severe pressure on both the angles, occasioning a fracture at the symphysis.

These fractures are sometimes double, both sides being affected, and are often compound so far as the mucous membrane is concerned.

Symptoms.—Great mobility of the fragments, crepitus; irregularity in the line of the teeth and arch of the jaw; dribbling of the saliva; inability to speak, with perhaps laceration of the mucous membrane. The displacement is greater when the fracture is near the symphysis; if on one side only of the middle line, the smaller fragment is liable to be drawn outwards and forwards, overlapping the larger, this being due to the action of the masseter and temporal muscles; if double, the middle fragment is depressed by the muscles attached to the hyoid bone. When the angle or ramus is the seat of fracture the muscles prevent deformity, but crepitus is perceptible to the patient, and pain increased on movement. The neck of the condyle when broken is much displaced upwards, inwards, and forwards by the external pterygoid, the chin being turned *towards* the affected side, and not *away from it*, as in dislocation.

Complications.—Suppuration, necrosis, paralysis and neuralgia from injury to the inferior dental nerve, injury

to the base of the skull, and salivary fistula.

Treatment.—A gutta-percha splint, or one made of pasteboard, with a four-tailed bandage; a four-tailed or muslin bandage and plaster of Paris may be used. Hamilton's sling prevents the anterior fragment being carried backwards. It consists of three straps, one of leather extending round the jaw and over the front of the top of the head, in a vertical direction; the other two are made of webbing, and pass horizontally round the head above the ear, the anterior being buckled to the forepart, and the posterior to the back part of the vertical one. Loosened teeth and necrosed pieces of bone are removed as soon as liberated. The patient must have a spoon diet for four or five weeks. In difficult cases interdental splints, or Hammond's wire splint, must be used; or the bone exposed, holes drilled in each fragment, and united by wire. If the condyle be displaced by the external pterygoid, reduction is effected by drawing the jaw horizontally forwards, and at the same time pushing the condyle outwards with the finger placed far back into the mouth. The jaw must be pressed upwards and backwards to fix the condyle in the glenoid cavity, and the jaw bandage applied. Gross recommends a thick graduated compress behind the angle of the bone to prevent this displacement. Rinse mouth with chlorate of potash gargles or Condyl's fluid.

Fractures of the Upper Jaw are much less frequent than those of the lower.

Causes.—Great and direct violence, as the passage of a cart-wheel over the face, gun-shot wounds, etc. In extraction of teeth the alveolus may be broken. Very rarely from indirect violence, as from falls on other parts of the face.

Symptoms are easily recognised if there be displacement, but when there is none, as in those cases in which the fracture involves the vertical plate of the palate bones, and pterygoid process of the sphenoid, the fracture can be easily known by passing the finger into the mouth, and pressing on the internal pterygoid plate; thus pain and mobility are ascertained.

Complications.—1. Teeth may be broken or dislocated; 2. Splintering of bone; 3. Hæmorrhage often profuse, not un-

frequently from the internal maxillary artery; 4. Nervous affections; 5. Injury to the base of the skull.

Treatment.—Hæmorrhage must be stopped by cold, styptics, or the actual cautery. Heath advises in obstinate cases laying open the face, and removing large fragments of bone, so as to apply the cautery more satisfactorily; he condemns ligature of the carotid. All splinters, however slightly adherent, are to be preserved, as they re-unite with wonderful facility. If the bone is displaced it is restored to position by the finger passed into the mouth, round the alveolus, aided by the introduction of a strong elevator or pair of dressing forceps into the nostril. The teeth may be wired together, or a gutta-percha splint adapted to the alveoli; in bad cases vulcanite interdental splints. If the superior maxillæ are separated, Hainsby's hare-lip compressor is useful. Liquid diet, or nutrient enemata. Swelling must be controlled by ice or evaporating lotions. If the fracture extends into the mouth this must be washed out with permanganate of potash, or chlorate of potash gargles.

Fractures of the Lower Extremity.

Fractures of the Bones of the Foot seldom present themselves except from direct violence, the result of severe crushes; they are then accompanied by considerable bruising and laceration of the soft parts, and frequently several bones are implicated. When simple, rest and attention to position suffice; if compound, removal of the part affected.

Fracture of the Calcaneum may be met with from falls on the heel. Should the bone be fractured in front of the ligaments, there is but slight displacement, the injury being recognised by the pain, swelling, flattening of the heel, and crepitus on grasping the back of the heel and making lateral movements. In other cases the posterior part is separated by muscular action behind the attachment of the interosseous ligament, the detached fragment being drawn up by the muscles of the calf, and projected posteriorly, crepitus is obtained on bringing fragments in apposition.

Treatment.—Subdue inflammation, gutta-percha splints and bandage. Flex the muscles of the calf by a tape attached to slipper on foot, and fastened to the thigh. The ankle should be fixed in all

fractures of the foot, millboard splints softened in hot water being adjusted to the side of the foot and reaching as high as the middle of the ankle.

Astragalus is rarely fractured *per se*, but occasionally this accident occurs from direct violence. The symptoms are eversion of the foot, crepitus on flexing and extending, and in some cases displacement, the posterior part being broken off and resting between the malleolus and tendo Achillis.

Treatment.—If the fragments are not displaced, a starch bandage is sufficient. If there be much displacement and reduction is not possible, the astragalus must be cut down on and removed, or amputation performed.

Fracture of the Bones of the Leg occurs from twists of the foot, either outwards or inwards, as catching it in a hole whilst running, etc., occasionally also from direct violence. There are four varieties of fracture met with at the lower end.

1. Fracture of the fibula two to three inches above the malleolus, with rupture of the internal lateral or deltoid ligament;
2. Pott's fracture (more common) the fibula being broken about three inches above the malleolus, with a fracture of the internal malleolus, and eversion of the foot from dislocation outwards;
3. Fracture of the fibula about three inches above the malleolus, with oblique fracture of the tibia downwards and inwards;
4. Fracture of the internal malleolus with rupture of the external lateral ligament, the foot being inverted.

Symptoms.—If the fibula only be broken the displacement is slight, with great pain—the seat of which is a good guide to the place of fracture—swelling, ecchymosis, crepitus obtained by pressing the bones together, and irregularity. Should the external malleolus be fractured, the depression above the separated fragment will disclose the accident, together with eversion of the foot by the peronei muscles, and undue projection of the internal malleolus beneath the skin. When the tibia is also broken the malleoli are widely separated, the ankle is increased in breadth, crepitus is readily obtained, there is a depression over the fractured seat, and the heel is drawn up by the muscles of the calf.

Treatment.—Reduce the fracture, a process which is aided by bending the knee. If there be little or no eversion

of the foot, two lateral hollow splints, one reaching from the knee to the extremity of the toes, whilst the internal only extends as far as the tarsus, are sufficient, with the limb supported in a cradle for three weeks, and then a starch bandage applied and worn for three weeks longer. When the eversion is very marked, the strong inferior tibio-fibular ligaments will be torn, an injury often termed Dupuytren's fracture, from the great surgeon who first described it. This is treated with Dupuytren's splint applied to the inner side of the leg, replaced at the end of three weeks by a starch or plaster of Paris bandage. If weight is borne by the leg before the sixth or seventh week, pronounced valgus is apt to occur. Fractures near the ankle joint are liable to leave a stiffness of joint and weakness of limb, lasting some months. Tendons round the ankle are prone to contract adhesions, leading to impaired utility of the joint.

Fractures of the Shafts.—When the lesion is situated at the upper part of the tibia the line of fracture is usually transverse, and the result of direct violence; at the lower part it is commonly oblique from above and behind, downwards and forwards, and from without inwards, resulting from indirect violence. Y-shaped fracture is also met with, and is apt to involve the joint, in some cases producing osteo-myelitis. From the close proximity of the bone to the skin the fracture is more often compound than any other bone of the body, arising either from the action of the violence occasioning it, or from subsequent movement driving the sharp fragment through the skin. If one bone alone be injured the sound one acts as a splint, preventing displacement, thus frequently the accident is overlooked, as considerable weight can be borne by the bone. In the case of the tibia, by feeling along the edge, irregularity, mobility, and indistinct crepitus can be detected, and in addition there is great pain with loss of power over the leg; the bone is to be grasped above and below the seat of the pain, and cautiously moved forwards, backwards, and from side to side. In the fibula the diagnosis is more difficult, from its being covered with thick muscles; the fingers should be placed a little above the malleolus, and the bones pressed together, if the fibula be sound it recoils in a

spring-like manner. When both bones are broken, the symptoms are shortening, mobility, crepitus, angular displacement, and eversion of the foot; the lower fragment is pulled upwards, outwards, and backwards by the action of the gastrocnemius. The fibula is generally broken at a higher level than the tibia. Rigidity or ankylosis of the knee or ankle is occasionally the result of this injury, such affections of the neighbouring joints being more prone to occur after fractures of the bones of the leg than in any other part of the osseous system.

Treatment.—When the displacement is slight, two hollowed lateral splints for a few days, followed by a starch bandage or plaster of Paris splint; if the deformity be greater, McIntyre's splint with Salter's cradle is useful, or putting the leg on its side and extending with the weight and pulley. Bryant advises division of the tendo Achillis when the fracture is close to the ankle and there is a difficulty in keeping the fragments in position. Gamgee recommends a straight millboard splint at the back, reaching from half-an-inch above the heel to four inches above the knee, and two lateral splints with foot pieces, extending to the same height. Each of these splints may be made in two lengths, which are joined by overlapping and bandaging; the whole limb is padded with gauze and cotton wool tissue.

Fractures of the Patella occur commonly from muscular action, the bone being snapped across, a little below its middle, whilst riding over the most prominent part of the condyles, by a sudden and forcible contraction of the quadriceps extensor; it may be also occasioned by direct violence, when the line of fracture is longitudinal in direction, and often the bone is comminuted.

Symptoms.—When transverse, the fragments are separated to the extent of an inch when the limb is extended, but this interval is increased on flexing the knee. There is complete loss of power over the joint, with inability to extend the knee or walk (in exceptional cases the ability to straighten the leg is not lost, the aponeurotic structures at the side of the patella not being torn through); local pain, and crepitus on drawing down the upper fragment and bringing it in apposition with the lower. When pressed from side to side the fragments can be

made out to move on each other, and on following the borders irregularity is perceptible. Great swelling ensues in a few hours from distension of the joint with blood or serum, and subsequently synovitis may occur. When the result of direct violence, the displacement is slight, and the accident is recognised by the pain, mobility of the fragments, and crepitus attending it. A patella that has been once broken transversely is very apt to again suffer the same injury, though not usually at the same place; again, it is not uncommon for the other patella to be affected in a similar manner.

Union is generally ligamentous or aponeurotic in transverse, and bony in longitudinal fractures.

Treatment.—Reduce the swelling and inflammation by rest and the application of evaporating lotions, the leg being raised, to relax the thigh muscles. If there be much blood in the joint, aspirate. As soon as the parts are in a suitable state, approximate the fragments by one of the following plans.

1. A straight wooden splint behind the knee, reaching from the buttock to the heel and terminating in a foot piece. The upper fragment is brought down by a strip of plaster applied over a pad of lint in figure of 8 manner; the limb is then bandaged from below upwards, the roller being passed at the knee round two hooks fixed to the splint. The limb and apparatus are raised. This appliance is worn for four weeks, being constantly readjusted; then a starch bandage is used for six weeks more, and afterwards a back splint or knee cap for another month, as the fragments, though united in good position, will by subsequent use of the limb become much more separated.

2. Middlesex Hospital Plan of Treatment.—“A broad piece of moleskin plaster cut out at one border, somewhat horse-shoe shaped, but with the ends of the curve prolonged, is fixed to the thigh, so that the curved edge is level with the normal position of the patella, and is retained by means of a few turns of a roller. Next, the limb is fixed upon a well padded McIntyre or simple wooden back splint, having a foot piece. Then the lower fragment of the patella is fixed by means of a pad of lint and a broad strip applied figure of 8 fashion round the limb and splint, and the ban-

dage which confines the foot and leg to the splint is continued upwards as far as this pad, which it assists in fixing. To the prolonged end of the moleskin plaster are sewn pieces of bandage which are attached in turn to India-rubber accumulators, one on each side of the leg; each of the accumulators at its lower end is fastened to a piece of bandage, and these are tied together below the foot board of the splint. With a pad of lint at the upper border of the superior fragment of the patella beneath the free edge of the moleskin, the requisite amount of tension is obtained by tightening the tied pieces of bandage."

3. Agnew's plan.—He uses a splint of pine board, somewhat convex longitudinally on the upper surface, thirty inches long, and five inches wide at one end, tapering to four inches at the other. On each side, a short distance above and below the middle of the board, are to be bored two holes, into which are fitted four pegs with square heads. The fragments are approximated by strips of plaster placed below the lower and above the upper, and wrapped round the pegs, which can be screwed so as to tighten the plaster.

4. Lund's plan.—Each fragment of the patella is transfixed with a stout steel needle (so fashioned at the point as to act as a drill) from side to side, and then held in position by a twisted suture on either side, passing over the ends of both needles. Care must be taken to keep the needles well away from the articulating surface of the patella so as to avoid opening the knee joint.

5. Malgaigne's hooks will draw the fragments closer together than any other method, but may cause diffuse inflammation round, or suppuration of the knee joint. Treves uses Malgaigne's hooks with aseptic precautions, and thus describes his method: "The limb is secured upon an ordinary straight back splint, so as to keep the knee fully extended. The splint has a foot piece which prevents any shifting, and is secured to the limb by straps and buckles. The knee, after being washed, is well purified by carbolic acid. The position of the patella is carefully marked out in pencil on the skin, and the sites for the points of the hooks indicated. It is important that the hooks should enter the bone at equal distances from

the median line. Four punctures are made now with a tenotome at the points at which the hooks are to enter. In each case the instrument should be passed down to the bone. The two upper punctures will open the synovial cavity, and through them the fluid in the joint is easily evacuated. The two lower punctures are without the joint. As soon as all the fluid has escaped the hooks are applied. They should be scrupulously clean, and highly polished, and should be kept in carbolic water while the punctures are being made. The two parts of the apparatus must be separated, and each portion applied by itself. It is not until the hooks have acquired a good hold of the bones that the two segments of the instrument should be screwed together. It is better to apply the lower hooks first; when well fixed they must be kept firmly in position by an assistant. There is often difficulty in inserting the upper hooks. Finally, the two segments are screwed together, so that the fragments of the patella are brought in close contact. There is a disposition for the upper end of the apparatus to "ride" a little; this is corrected by passing a tape over the upper hooks, and under the knee, and fixing it by a leaden clamp. The operation should be performed under the carbolic spray without an anæsthetic. After the hooks are secured, the spray is discontinued, and the four punctures well covered with iodoform. The screw must be kept well oiled, the limb placed on an inclined plane, and fully exposed to the air. The hooks may be removed in six weeks.

6. Lister's plan.—In cases where the knee is useless, owing to great separation of the fragments, Lister cuts down on the bone with strict aseptic precautions, and wires the fragments together, the knee being carefully drained.

7. Other methods are the strap and spiral bandage of Sanborn, calliper splint, Steavenson's elastic bands, subcutaneous division of the insertion of quadriceps femoris into the patella, etc.

For longitudinal fracture, a starch or plaster of Paris bandage is sufficient.

Fractures of the Femur.—Lower end may be broken: 1. Between the epiphysis and the shaft. The nucleus appears in this epiphysis at the eighth

month of fetal life, and the epiphysis unites with the shaft from the twenty-first to the twenty-fourth year; only the anterior edge of these epiphysial lines is within the synovial membrane. 2. Either condyle may be fractured. 3. T-shaped into the joint. 4. Above the condyles (supra-condyloid), which does not involve the knee joint.

Symptoms of the second and third are considerable swelling of the joint from effusion of blood and serum, as well as into the adjacent tissues, crepitus, the line of fracture is readily felt, reduction of the displacement by direct lateral pressure, abnormal mobility can be easily detected by manipulating the joint or grasping the condyles. If the patella is rubbed over the condyloid notch, its unevenness can be felt. When the condyles are separated from one another, there is an increase in the breadth of the lower end of the femur. Inflammation of the knee joint may occur. In the first and fourth varieties the lower fragment is flexed on the tibia by the action of the gastrocnemius, soleus, and plantaris, so that its fractured end is often perceptible in the popliteal space; the upper fragment rests on the anterior surface of the lower. Occasionally the upper fragment may pass behind the lower, and press on the popliteal vessels, even causing gangrene. Crepitus is less distinct or absent in separation of the epiphysis, and this may be followed by imperfect development of the lower end of the femur.

Treatment.—Double inclined plane, which may be slung, or a McIntyre's splint with a long thigh piece, or any of the methods used for fracture of the shaft. Treat the joint, if involved, by ice, etc. Bryant advises division of the tendo Achillis, and the long double splint in fractures of the lower third above the condyles. Shortening from $1\frac{1}{2}$ to 2 inches will often be left after the most skilful treatment.

Of the Shaft.—This may be fractured at any part, but most commonly in the middle third; the proportion being six in the middle third, to three in the lower, and two in the upper. These fractures are, as a rule, oblique in adults and transverse in children; they are generally caused by direct violence, occasionally by indirect, and rarely by muscular action.

Symptoms.—Shortening, rotation of the foot outwards, crepitus, swelling, loss of power, and increased mobility. In the lower third the lower fragment is drawn behind and inside the superior. When the bone is broken in or above the middle third, the upper fragment is drawn forwards by the psoas and iliacus, and generally outwards, and also everted by the external rotators, but occasionally inwards by the internal rotators; the lower fragment is drawn upwards and inwards. In the middle third the line of fracture is very uniform, being downwards and from behind forwards.

Treatment.—The patient should be anæsthetised, and then one of the following appliances used: Bryant's double splint, Liston's long splint and perineal band, Nathan Smith's wire splint to the anterior surface with suspension, or Hodgen's suspension splint to the posterior aspect, double inclined plane weight extension with short splints to the thigh or sand bags (capital in children), plaster of Paris or starch bandage. If the long splint be used it should be replaced in three weeks by a starch or plaster of Paris bandage, and this may be used from the first in the case of children, though weight extension is much preferable. Bryant recommends vertical extension in children, the injured and sound limbs being flexed at right angles with the pelvis, fixed by some rigid splints, and hoisted upwards to the cradle, hook, or bar above the bed. In adults there is always some shortening under any mode of treatment, about three-quarters of an inch; but this is of no consequence, as the patient corrects it by a slight obliquity of the pelvis. In children the fracture takes six weeks to unite firmly, in adults twelve. The surgeon, before dismissing the patient, must always ascertain the movements of the knee are free by manipulation, giving, if necessary, an anæsthetic. In these fractures Gamgee recommends this procedure: "The patient is laid in a horizontal position; one assistant is charged with the duty of making extension from the foot, another with that of counter extending by means of a jack towel round the groin. The first step is to secure co-aptation of the fragments by fixing the hip and knee, and compressing the thigh muscles. For this purpose three splints are required.

They should be long enough to reach from a couple of inches below the knee upwards; the inner one to the rami of the ischium and pubes, the outer and posterior one to the iliac crest." The outer and inner one should be two and a half to four inches in width, according to the size of the thigh; the posterior one below is the same width as the popliteal space, widening so that its upper part covers the whole buttock. These millboard splints are soaked and well padded. It is a matter of great importance to fix the hip joint, and the bandage must be well spread out over the gluteal region. By making several figures of 8 round the pelvis, and passing the bandage alternately above and below the anterior superior spine, it is prevented from slipping on to the abdomen. The leg is then encased in millboard apparatus, extending from the sides of the foot to the middle of the thigh, and overlapping the thigh splints; an outer coating of gum or starch completes the apparatus.

Of the Upper End.—Fractures of the upper part are classified into: 1. Intracapsular; 2. Impacted intracapsular; 3. Extracapsular; 4. Impacted extracapsular; 5. Separation of the great trochanter; 6. Separation of epiphysis.

1. *Intracapsular* is a common accident in persons over fifty, especially women. It is occasioned by slight indirect violence, as catching the foot and tripping, stepping unexpectedly, slipping on a stone, etc. The line of fracture is generally oblique from above downwards. Rodet concludes that if the person has fallen on the foot or the knee the fracture will be oblique intracapsular; if the front of the trochanter has received the blow, transverse intracapsular; if the fall has been on the back of the trochanter the fracture will be partly within and partly without the capsular ligament; and if the fall has been fairly on the side of the trochanter, so that the force has been directed transversely, the fracture will be entirely extracapsular and transverse in reference to the long axis of the neck. The liability to this fracture is due to the changes the neck of the femur undergoes as a result of advancing age, namely, interstitial absorption with fatty degeneration and a change of shape, its angle becoming a right instead of an oblique one.

The *symptoms* are: 1. Flattening of the hip. 2. Alteration in the position of the trochanter, it being less prominent than natural, and nearer to the anterior iliac spine and the middle line of the body; on rotation it moves round its own axis, instead of describing an arc of a circle. 3. Pain, particularly on rotation outwards, may be referred to the knee. 4. Crepitus, on drawing down the limb and rotating it; but this is often indistinct. Agnew recommends flexing the thigh to a right angle with the pelvis, and rotating it whilst traction is made. 5. *Eversion* of the limb from the action of the external rotator muscles, its own weight, and the back of the neck, which is thinner and more brittle, being more extensively broken than the front. Inversion exceptionally may be present when the fracture arises from direct violence, which paralyses the external rotators, and so enables the internal rotator muscles to invert the limb, or owing to the lower fragment being in front of the upper one, or to interlocking of the fragments. In addition to the eversion, the knee is semiflexed, and the toes point outwards, and by pressure with the hand may be made to look backwards.

6. Shortening of the limb, at first slight ($\frac{1}{2}$ inch to 1 inch), but gradually increasing from rupture of the capsular ligament, and absorption of the head.

7. Swelling about the joint and groin, not attended with bruising as a rule.

8. Increased mobility. Maissonneuve uses the following plan to test the mobility. The patient is placed on his abdomen and the injured thigh carried directly backwards, in which direction, if it be broken, it will go much further than when sound, as in the latter case the movement is arrested by the neck of the bone striking against the margin of the acetabulum.

9. Loss of power. All power of motion by the patient is usually lost, but in some cases the patient can raise the leg, or even walk some distance, due to impaction or the capsule not being completely torn. Agnew relates the case of a patient who walked in the Pennsylvania hospital after the accident a distance of two squares, and also made his way to the third storey of the building: this injury was verified post mortem. Several tests are used for diagnostic purposes. (a) Nélaton's test line.

(β) Bryant's. (γ) Morris's bi-trochanteric, or transverse measurement.

(α) *Nélaton's test line.*—A line is drawn from anterior superior spine of the ileum to the most prominent point of the ischial tuberosity, this in the normal hip in all positions of the joint touches the top of the great trochanter; in fracture of the neck or dorsal dislocation the trochanter lies above or behind this line.

(β) *Bryant's test line.*—"For purposes of demonstration I have described it as the base of the ilio-femoral triangle, the two sides of the triangle being made up of two lines drawn from the anterior superior spinous processes of the ilium, one of them, AC, being vertical, and traversing the outside of the hip to the horizontal plane of the body; and the second, AB, impinging on the top of the trochanter major, and corresponding in the normal position of the hip joint to the anterior half of Nélaton's test line for dislocation of the femur backwards. The test line CB for fracture, or shortening of the neck, joins the two at right angles to the vertical line, and extends from it to the trochanter. Any shortening of the line on comparing it with the same taken on the uninjured side, indicates, with precision, a shortening of the neck of the thigh bone." For practical purposes, the line drawn through both anterior spinous processes, and the short perpendicular line let fall from this to the top of the great trochanter, are alone required. To compare the sides of the body the pelvis must be straight.

(γ) Morris's bi-trochanteric, or transverse measurement, "consists in measuring the distance from the median line of the body to the antero-posterior line at right angles to the long axis of the body, through the top of the trochanter on each side. This distance is always less on the side of the fracture."

The dangers of the accident are the onset of low congestive inflammation of the lungs, bed sores, cystitis, etc.

Union.—From the difficulty of keeping the parts in apposition, presence of synovial effusion, loss of vascular supply, and the age and feebleness of the patient, bony union is extremely rare and practically unattainable, the junction being either fibrous, or a false joint forming by the detached head becoming hollowed

out and receiving the rounded neck in its socket.

2. *Impacted Intracapsular* is known by the symptoms being less marked, except shortening. The limb cannot be brought to its proper length by extension. Crepitus is absent, and there is less eversion and loss of power in the limb. The trochanteric may be impacted in acetabular fragment, but more usually fragments are locked in each other in a serrated outline. This accident is more likely to be followed by osseous union, and to assist this, on no account must the fractured surfaces be separated; the deformity is permanent. It must be remembered that after some contusions of the hip without fracture, eversion, shortening, etc., may occur from chronic inflammation and rarefying osteitis, so that in contusion a cautious prognosis should always be given, or the surgeon may be unjustly blamed.

Treatment.—Keep the patient in bed, with the knee supported by a pillow, for two or three weeks, until the pain subsides, together with a weight and pulley, or fixing the limbs together; then apply a leather splint or starch bandage to the hip, and direct the patient to walk on crutches. Finally, the patient will be able to get about by means of a stick and a high heeled boot, a greater or less degree of lameness being permanent. When there is very slight separation, and the patient's age is favourable, bony union may be tried for by the weight and pulley, Thomas's splint, the long splint, or the double inclined plane with a bandage round the hips, for two or three months, liberal diet, and a water bed, and then a starch bandage and crutches.

3. *Extracapsular Fracture* is most frequent between thirty and forty; occurs from direct violence, and both sexes are liable. The bone is broken just outside the insertion of the capsule corresponding to the anterior and posterior inter-trochanteric lines, being usually comminuted, owing to the lower end of the neck being driven into the trochanter, which is detached or splintered. According to Hamilton the direction of the fracture in the outer fragment is very uniform, the great trochanter being divided from near its summit obliquely downwards and forwards towards its base, and the line of fracture terminating a little short

of the small trochanter, or penetrating beneath its base; one or two lines usually traverse the great trochanter horizontally.

The *symptoms* are: 1. Considerable swelling, ecchymosis, and extravasation. 2. Great pain. 3. Eversion. 4. Shortening from 1 inch to $2\frac{1}{2}$ inches, or more—it can be made to disappear on drawing down the limb. 5. Crepitus is very distinct, and can be easily felt on placing the hand on the trochanter and

rotating the limb. 6. Loss of power of motion. Extracapsular can be distinguished from intracapsular by the greater force required to produce it, the age of the patient, more marked injury to the soft parts, larger amount of shortening, and well-marked crepitus. If the trochanter does not move with the lower fragments fracture is certainly extracapsular. The following table, slightly altered from Agnew, is useful for diagnosis:—

INTRACAPSULAR FRACTURE.	EXTRACAPSULAR FRACTURE.	POSTERIOR LUXATION.
1. Produced by trifling violence at any point of the limb.	Considerable violence, most frequently upon the great trochanter.	Great violence applied to the limb, the thigh being in a state of adduction.
2. Sex. Most common in females.	Sexes about alike as to frequency.	Most frequent in males.
3. Age. 50 and upwards.	Under or over 50.	From 15 to 45 years of age.
4. Position. Foot rest on the outer side.	Rests on the outer side, if impacted may be at any degree of eversion.	Limb inverted and adducted.
5. Shortening, very variable, may be none, generally not over an inch. May occur suddenly or gradually; readily removed by extension, and returns when the force is removed.	From 1 to $2\frac{1}{2}$ inches, may increase, but if impacted remains the same. Moderate extension will restore the limb to its length. If impacted, requires much force to do so.	From $1\frac{1}{2}$ to 2 inches. When restored to its proper length, by extension, does not return.
6. Mobility very great.	Mobility great unless the fracture be impacted.	Limb more fixed and rigid.
7. Crepitation not very distinct.	Distinct unless impacted.	No crepitation.
8. From the summit of the great trochanter to the tuberosity of femoral condyles no shortening.	Shortening between these points.	No shortening.
9. Pain not severe, felt most, near to trochanter minor.	Generally severe, and felt over trochanter major.	Not severe, but extending down back of thigh.
10. Disability great.	Disability great, but may bear, if impacted, some weight on the foot.	Helpless, cannot endure the least weight on the foot.
11. Contusion and discolouration little.	Often much.	Rarely any.
12. Wasting of the limb and continued weakness.	Little if any wasting, temporary weakness.	Rarely any.

4. *Impacted Extracapsular Fracture*—The neck being buried in the cancellated tissue of the trochanter and shaft of the femur. This variety is more common than the simple extracapsular fracture. The symptoms are: 1. Absence of crepitus. 2. Pain. 3. Swelling and marks of direct injury to the hip. 4. Shortening from half to three-quarters of an inch, which does not disappear on

traction unless the impaction be broken down. 5. Eversion, but less marked than in simple fracture. 6. Flattening of the hip and increase in breadth from before backwards. 7. Trochanter moves through a small arc on rotation. 8. Loss of power is incomplete, as the patient can raise the limb or even walk, though this is very painful.

Dangers of extracapsular fracture are

from injury to the soft parts, the direct result of the violence causing the accident. Some degree of lameness will always remain even under the most favourable circumstances. Union is osseous. The following table gives a concise view of the four fractures:—

INTRACAPSULAR.	IMPACTED INTRA-CAPSULAR.	EXTRACAPSULAR.	IMPACTED EXTRA-CAPSULAR.
1. Shortening $\frac{1}{4}$ inch to 1 inch. Easily removed by extension.	Very slight, cannot easily be removed.	1 in. to 2 $\frac{1}{2}$ in.	$\frac{1}{2}$ in. to 1 in.
2. Eversion. Inversion rare.	Slight eversion.	Eversion. Inversion rare.	Slight eversion, sometimes neither inverted or everted, sometimes inverted.
3. Crepitus not readily detected.	No crepitus.	Crepitus easily detected.	No crepitus.
4. Trochanter less prominent than natural; usually turned outwards.	Trochanter, rather less prominent than natural.	Trochanter still less prominent, usually turned backwards.	Trochanter considerably less prominent than natural.
5. Trochanter on rotation moves in a segment of a circle, having a radius much shorter than natural.	Trochanter on rotation moves in a segment of a circle whose radius is little shorter than natural.	Trochanter on rotation moves on the axis of the shaft.	Trochanter on rotation moves in a segment of a circle, whose radius is considerably shorter than natural.
6. Limb movable to surgeon, immovable to voluntary efforts of the patient.	Limb movable to surgeon, but powerless to patient.	Do.	Do.
7. Pain and constitutional disturbance slight.	Do.	Pain and constitutional disturbance generally considerable.	Do.
8. No ecchymosis nor other marks of external injury to hips.	Do.	Ecchymosis, swelling, and other marks of injury to hips.	Do.
9. Usually caused by indirect violence.	Do.	Usually caused by direct violence.	Do.
10. Age, rarely below 50, most common in aged females.	Do.	Usually below 50. Most common in healthy adults.	Most common in adults
11. Fracture may be oblique or transverse, with or without laceration of the capsular ligament or periosteal covering.	Outer fragment may be driven into the inner, most common double impaction by serrations.	Fracture most frequently where the neck joins the trochanter, almost invariably accompanied by fracture in the intertrochanteric space.	Inner fragment usually driven into the outer.
12. Bony union very rare.	Bony union frequent.	Bony union common.	Bony union usual.

Treatment.—Bryant's double splint, long splint, double inclined plane with a bandage round the hips, weight and pulley, or plaster and starch bandage.

5. *Trochanter major* is broken by direct violence, and may be comminuted. The

trochanter is separated both from the neck and shaft of the femur.

Symptoms.—Displacement of separated fragment upwards, inwards, and backwards; crepitus on flexing, rotating out and abducting the thigh, the upper frag-

ment being brought down; pressure on the hip is very painful; no shortening; eversion of the foot; considerable swelling; inability to sit down. This fracture is often combined with extracapsular fracture of the neck of the femur.

Treatment.—A starch bandage; the union is generally ligamentous.

6. *Separation of the Epiphysis.*—At the time of birth there is no real neck, but simply a groove between the head and trochanter; along this groove capsule and synovial membrane are attached. After two or three weeks a neck is formed from the shaft, which also forms a large part of the head. Ossification runs in the shape of a wedge upwards, so that all the upper extremity of the diaphysis is placed between the epiphysis of the head and the centre for the great trochanter; all this part including the head is enclosed in the synovial membrane. The nucleus appears at the first year. Epiphysis unites at eighteen. The symptoms are similar to extracapsular fracture.

Treatment.—Union will generally take place under appropriate treatment. Weight and pulley for extension; plaster

of Paris bandage round pelvis and thigh; sandbags on each side of the limb. At the end of three weeks cautious passive movements of the joint.

Fracture of Pelvis occurs from extreme direct violence, the most usual cause being railway injuries, particularly buffer accidents. It may be situated across the thyroid foramen, crest of ilium, acetabulum, etc. These fractures are dangerous on account of the liability of injury to the pelvic organs, as rupture of the bladder and urethra, with extravasation of urine, laceration of the rectum or intra-pelvic vessels, etc. The symptoms are inability to walk, though the patient can move his limbs in bed; crepitus obtained by pressing on both crests of the ilium; pain on moving or coughing. Displacement recognised either by external examination, or per rectum or vaginam.

Treatment.—Absolute rest in bed for six weeks or two months. Pass a catheter, and apply a broad flannel roller round the pelvis. The surgeon must be on his guard and watch for the formation of abscesses. For complications, *vide* chap. xxx.

CHAPTER XIII.

DISEASES OF BONES.

Periostitis—Ostitis—Osteo-Myelitis—Chronic Abscess—Caries—Necrosis—Osteo-malacia—Rickets—Tumours.

Periostitis, or inflammation of the periosteum, may be acute or chronic. There are two forms of acute periostitis—the simple and the diffuse.

Causes.—Injuries, blows, kicks, and the like; syphilis, rheumatism, following the exanthemata. In adults the disease is generally traumatic and local; but in children and young adults the periostitis is often due to constitutional causes, is of the diffuse variety, a considerable extent being implicated, and is rapidly followed by suppuration, with the presence of micro-organisms in the pus.

Pathology.—When acute and simple the superficial layer of the membrane is swollen and red, then an exudation of liquor sanguinis and leucocytes follows, and the part is converted into pus mixed with debris. The tissues above are in-

flamed, and also the bone beneath. The exudation from the surface of the subjacent osseous tissue raises the periosteum, forming a periosteal abscess, the floor of which consists of bare bone or granulation tissue. Necrosis and caries sometimes supervene, from the vascular supply of the bone being diminished, owing to loosening and stripping of the periosteum. In the diffuse form the inflammation rapidly proceeds to suppuration, the pus spreading quickly up and down the bone underneath the periosteum. If the disease commences in the diaphysis it does not invade the epiphysial line, but if it begins at the latter site, or in its neighbourhood, the whole of the shaft may lie free in an abscess cavity. At times, when commencing in the epiphysial line, it is con-

joined with diffuse osteomyelitis, and terminates in total necrosis. If the epiphysis, with or without the shaft, be affected, suppurative arthritis is common. Pyæmia is a frequent complication. The thickened periosteum resists the escape of the contained abscess, which grows larger and larger, until finally the membrane gives way, and the huge stream of pus diffuses itself among the muscles.

When chronic in character, lymph is effused by the inflamed periosteum and bone; this becomes organised into fresh osseous tissue (periosteal ossification), which forms a node. This process is often termed osteo-plastic periostitis.

Symptoms.—Acute simple periostitis is recognised by throbbing pain, *worse at night*, and increased on pressure; swelling limited, superficial, hard, elongated, and puffy; extreme tenderness on pressure; heat observed on palpation; with finally œdema and redness of the skin. The constitutional symptoms are those of inflammatory fever.

Acute diffuse periostitis, as before stated, is limited to children and young adults, and most commonly attacks the tibia, femur, or humerus. It is generally met with in weakly persons following an injury. The symptoms may at once set in, or there may be an interval of from four to five days. It is characterised by shiverings or rigors, high fever, headache, loss of appetite, vomiting or diarrhœa; delirium is apt to be present from the commencement. The local symptoms appear in two or three days, and manifest themselves by pain and diffuse red œdematous swelling.

Chronic periostitis is known by nocturnal pain, thickening and induration of the bone. The superficial parts are unaffected. Some tenderness is often present.

Treatment.—For acute simple periostitis, leeches along the bone, rest, and elevation of the part, followed up by hot fomentations. Painting the whole limb with tinct. iodi. is often serviceable. Calomel, antimony, and salines, with opium or morphia to relieve the pain. If there be marked œdema, and in all cases of acute periostitis, where the pain is great and the pyrexia continuous, make a free incision through the periosteum down to the bone, giving, if necessary, an anæsthetic. Insert a drainage

tube, and wash out with an antiseptic lotion. When the pyrexia is subdued, administer tonics and a generous diet.

For Diffuse Periostitis.—Elevate the limb and paint with tinct. iodi. twice in the twelve hours. Brisk purgation; if there be no relief in thirty-six hours, blister and apply a poultice. As soon as suppuration is diagnosed make several incisions down to the bone with aseptic precautions; the finger is passed into the wounds to ascertain the most dependent position, which should always be freely opened, and to establish accurately the amount of pericosteum separated. Absolute rest on a suitable splint is necessary. Quinine and iron. Good diet with stimulants. Opium and belladonna to relieve pain. If the whole shaft is necrosed and separated from its epiphyses, the dead bone should be removed as soon as possible by subperiosteal resection, before new bone is formed from the periosteum to invaginate the sequestrum. Amputation is necessary in cases where adjacent joints are attacked with suppurative arthritis, or patient is sinking from exhaustion. For chronic periostitis, iodide of potassium in gr. x doses, combined with tinct. opii, tinct. belladonn., and sp. ammon. arom. Repeated blistering, or lin. iodi, ung. hydrarg., or oleate of mercury, with pressure by a well-adjusted bandage. If disease does not yield to iodide give mercury by the mouth; when still obstinate, free division of periosteum at the tender place.

Ostitis, or inflammation of the osseous tissue, is most commonly met with in the tibia, femur, skull, sternum, ribs, and bones of the hand and foot.

Causes.—Injury, syphilis, rheumatism, exposure to cold, damp, or malaria.

Pathology.—When a portion of bone is inflamed the blood vessels in the Haversian canals dilate and form loops, round these there is an exudation of leucocytes and liquor sanguinis, which form a granulation tissue consisting of osteoclasts (exuded leucocytes), with a sparse intercellular substance, and a few large multinucleated cells (myeloid cells). The periosteum is swollen and engorged, and the seat of hyperæmia being readily separable from the bone, whilst the medulla is similarly affected. The osseous lamellæ are absorbed, forming irregular spaces filled with granula-

tion tissue (Howship's lacunæ). The latter tissue increases, the bone becoming more vascular, soft, and spongy. This process is termed simple rarefying osteitis, or simple caries. At the same time that this rarefaction is proceeding, new bone is produced under the periosteum and within the medullary canal. If the inflammation be acute, pus is formed, from the granulations breaking down (abscess of bone); if chronic, the granulation tissue is developed into hard, compact osseous substance which fills the Haversian canals, increasing the weight of the bone; the periosteum at the same time forms new bone. The new bone may be as hard as ivory, and may even cause necrosis by obliterating all the vessels (condensation or osteosclerosis).

Symptoms.—Deep, dull, aching pain, worse at night and increased by movement, but diminished when the limb is raised. Tenderness on pressure, not great at first. The shape of the bone is altered, it being enlarged and tender on palpation. There may be œdema and slight pitting on pressure. Inflammatory fever.

Treatment.—Rest on splint, and elevation of the part. Leeches. Warm lead and opium fomentations. Calomel and opium internally. If pain and fever continue, make incisions with a tenotome, and drill the bone in various directions. In chronic cases, rest, repeated blistering, painting with strong lin. iodine, ung. hydrarg., or oleate of mercury. Linear osteotomy, and removal of portion of inflamed bone with the trephine or gouge. Iodide of potassium in large doses, in syphilitic cases.

Osteo-Myelitis or diffuse inflammation of the medulla of bone is an acute septic inflammation, attacking the medullary membrane and adjoining cancellous tissue, usually terminating in the death of the bone.

Causes.—1. Injury, implicating and laying open the medullary cavity, either the result of accident, as compound fracture or gunshot wounds, or subsequent to an operation, as amputation. 2. Destructive disease of a joint. 3. An idiopathic form is described, arising spontaneously or after cold; also subsequent to acute infectious diseases, as typhus, scarlet fever, or measles; this variety originates without an open

wound, and is due to the production of micro-organisms.

Symptoms.—Pain of a deep throbbing or aching character, and occupying the centre of the limb. The affected part feels exceedingly heavy. From the fifth to the eighth day deep local swelling of the whole limb is present, œdematous and doughy on the surface, but hard beneath, with a well marked edge; the skin is almost of a natural hue. There is much tenderness on pressure. If there be a wound there is profuse suppuration, and the exposed bone is dry and yellow, with the periosteum stripped off.

Constitutional Symptoms.—Rigors and sharp pains usher in the attack, followed by pyrexia and typhoid symptoms; the temperature varies from 100° to 105°. At the end of the second week the pyrexia diminishes. The disease may terminate in septicæmia and death, necrosis, or resolution.

The periosteum and outer surface of the bone is congested, and on making a longitudinal section, the medullary canal is found full of pus, mixed with fat globules, the membrane is swollen, vascular, soft, of a deep red colour, and may even be black and gangrenous. The cancellous tissue is of a bright pink hue, and softened, with the Haversian canals enlarged and filled with inflammatory products. When the disease occurs near the line of the epiphysis, the junction of this with the shaft is affected, leading to its separation, and in severe cases to it necrosing and forming a sequestrum (acute epiphysitis).

Secondary Joint Affections.—1. Serous synovitis produced by extension of the inflammation from the periosteum. 2. Passive serous effusion from pressure on and thrombosis of the veins leading from the joint. 3. Muco-purulent effusion into the synovial membrane. 4. Pyæmia. 5. Suppurative arthritis.

Treatment.—As general measures, a nourishing diet and stimulating plan of treatment, with due attention to hygienic conditions. Give opiates subcutaneously or per rectum. Quinine or sulpho-carbolic acid of sodium are the best therapeutic remedies.

Locally. All wounds implicating the bones should be treated antiseptically, and preferably after Lister's method. Give a free outlet to all discharges by means of counter openings and drainage tubes.

The limb should be put on a splint and slung. Hot compresses covered with mackintosh are useful. If there be a subperiosteal abscess this should be evacuated under aseptic precautions; should much oil float on the surface of the pus, perforate the bone with a carpenter's gimlet and wash out the medulla with a solution of chloride of zinc (gr. xl to ʒi). A drainage tube is inserted and the wound left open. When there is a wound communicating with the medulla the whole of this may be scraped out, and iodoform put in the canal. If septicæmia set in, amputate through the joint next above the affected bone at once, except in the case of the thigh, which should be removed through the trochanters.

Chronic Abscess of Bone appears usually in the cancellated tissue on the superficial side of the bone, especially frequenting the lower end of the femur, and head and lower end of the tibia.

Causes.—Injuries from blows, kicks, and the like. Rheumatism, struma, syphilis.

Symptoms.—Remittent pain occurring in paroxysms, worse at night and associated with circumscribed tenderness *always at the same spot*. Slight enlargement of the bone, with perhaps a rigor at the onset. These symptoms in adults last a considerable time, even years, but in young life, if the disease be not treated, inflammation is prone to occur in the neighbouring joint, and finally the abscess may burst into it.

Treatment.—Apply Esmarch's tourniquet and make an incision down to the bone at the tender spot, then make an exit for the contents of the abscess by drilling through the bone, or trephining a small portion of it, or by linear osteotomy with a Hey's saw. If no pus be found, pierce the neighbouring bone with a sharp instrument, as a bradawl, for the cavity of the abscess may lie to one side of the opening. Free drainage, irrigation with antiseptics and iodoform. The operation is often somewhat troublesome owing to the bone being thickened round the abscess by sclerosing osteitis.

Strumous Rarefying Osteitis, or Strumous Caries, differs from simple rarefying osteitis in degree, but not in nature; there is more softening, more extensive degeneration of neigh-

bouring tissue, and less attempt at repair. Caries is molecular disintegration of bone resembling ulceration of the soft parts, and resulting from inflammatory processes. It has already been stated that inflammation of bone leads to the formation of a granulation tissue at the expense of the osseous structure. This change may stop short of suppuration, the granulation tissue being organised into bone and fibrous tissue (*caries fungosa*). If suppuration occur, when the bone is only affected superficially, it is destroyed, presenting a rugged, irregular, excavated surface, the floor of which consists of cancellous structure, which, in many cases, has undergone a sclerosing transformation. When occurring in the interior of bone the exudation is purulent and the granulation tissue destroyed, the inflammatory debris being with difficulty removed, forms an abscess: the carious cavity contains sanious pus, minute particles of dead bone and molecular debris. The abscess may remain quiescent or open on the surface or into the joint; in other cases the granulation tissue, instead of being absorbed or converted into pus, undergoes fatty degeneration and caseation (*dry caries* or *caries sicca*). Carious bone is porous, of a grey, brown, or black colour, partly disintegrated into softened masses, and partly hollowed out into cells containing a reddish brown oily fluid. Caries most frequently attacks the cancellous tissue, and is common in the epiphysial ends of bones, where it may, by affecting the cartilage, give rise to disease of adjacent joints. It is necessary to refer here to tubercle of bone, which may be discrete or confluent (from the junction of discrete tubercles); it occurs as miliary granulations, which obliterate vessels of the Haversian canals and medullary spaces, producing rarefying osteitis. The products undergo fatty degeneration and caseation from pressure on and thrombosis of the vessels. It results either from general tuberculosis or from local infection subsequent to strumous osteitis. The vertebræ, carpus, tarsus, and sternum, are the favourite seats.

Causes.—The strumous diathesis: the tarsus, carpus, spine, head of the tibia, sternum, ribs, and temporal bone are the chief localities. Slight injuries,

occasioning inflammation, are the general exciting cause. The tubercular diathesis originates tubercular disease of bone. It is at present a disputed point whether strumous rarefying osteitis is not always due to the presence of the tubercular bacillus.

Symptoms.—Pain in the bone, increased at night, followed at a greater or less interval by redness and swelling of the tissues covering it. Abscesses form and burst, discharging a thin watery pus. On passing a probe the rough, bare, and soft bone is easily recognised, and readily bleeds when

touched. The abscess contracts, forming a fistula, discharging a fetid pus, dark and sanious, mixed with particles of diseased bone and phosphatic lime salts. The fistulous opening is surrounded with high, spongy, bright crimson granulations, which are apt to bleed, and are encompassed by thin, blue, contracted skin. Tubercle is liable to occur in the lungs, and meninges of the brain; and degeneration of the liver, spleen, and kidneys, together with hectic fever. Diagnosis between strumous articular osteitis and strumous synovitis (Barwell).

STRUMOUS ARTICULAR OSTITIS.	STRUMOUS SYNOVITIS.
<ol style="list-style-type: none"> 1. The first symptom is heavy, dull pain, with limping or other imperfection in the use of the limb. This comes on before any swelling is perceptible. 2. The pain is generally increased in bed, and is subject to variations; sometimes quite disappearing for a time and again returning. 3. The swelling at first is confined to one bone of the joint; for instance, at the knee the upper when the femur, the lower when the tibia is affected. Afterwards, although the whole joint is enlarged, the tumefaction is more marked, harder, and larger over the bone primarily affected, and is nearly always on one side of the joint. The division between the constituent bones remains evident to the touch. 4. In all but the deepest placed bones the integument over them is sensibly hotter. 5. Retraction of muscles, often without any starting pains, is an early symptom. 	<ol style="list-style-type: none"> 1. The swelling is either before the pain or is discovered with the pain. 2. Pain is a later symptom as regards visible swelling, yet when it comes on is constant. 3. The bones forming the articulation are blended by the swelling into one rounded, shapeless mass, which overlies both parts of the joint equally, and conceals greatly or altogether the line of junction between the two bones. There is no preference of place, the swelling is equable over the whole joint. 4. The integuments are not at all or scarcely increased in temperature. 5. Retraction of muscles, accompanied or preceded by starting pains, is a late symptom.

Treatment. — Constitutional. Rest. Attention to the general health and constitutional causes. Antiphlogistic remedies at first, then ol. morrh., syr. ferr. phosph. co., or the iodides. Change of air to the sea-side is often serviceable. — Locally. The bone is thoroughly exposed and one of the following preparations applied as often as necessary: acetic acid (1 to 5); sulphuric acid diluted with equal parts of water, and then pure; iodine at first diluted, then pure; solution of iodoform. In deep caries destroy with Vienna paste, or potass. c. calce, the soft parts down to the bone, and afterwards apply the caustic to the osseous structure. In superficial caries the actual or galvanic cautery may be

used. Chassaignac employs hydrochloric acid. Fitzpatrick destroys the sinuses, and exposes the bone with Vienna paste, cuts into the osseous tissue with a trephine, and applies the caustic freely. Another escharotic, which is beneficial, is the liquor of Villatte, consisting of zinci sulph., cupric sulph. āā gr. xv, liq. plumb. subacet. fʒss, acid. acet. dil. fʒiijss. Pirrie recommends red precipitate of mercury in superficial caries attacking young persons. If these measures be unsuccessful the carious bone must be removed by operation. An Esmarch's bandage is applied, the bone exposed by a crucial incision, and the diseased part taken away by means of the gouge, osteotrite, gouge forceps, etc., until hard

pink and vascular bone is reached. Gross advises as a diagnostic sign as to the amount of bone to be removed, that the fragments should be washed in water, when if they be carious they will exhibit a whitish, greyish, greenish, or blackish appearance; whereas if healthy they will be found to be vascular and red, and retain their normal characteristics. The unhealthy granulations lining the sinuses, are scraped away with a Volkmann's spoon. The cavity is dressed from the bottom with lint soaked in an antiseptic, as chloride of zinc solution. The lint is removed in twenty-four hours, and absorbent aseptic dressing applied; free drainage and iodoform are necessary. Rest on a splint is always essential. If a joint be affected, excision in suitable cases must be practised; should the whole bone be implicated, resection or amputation becomes necessary.

Necrosis is that series of changes causing the death of a bone, or portion of bone, *en masse*, similarly to the process of gangrene in the soft parts. It chiefly attacks the compact osseous tissue.

Causes.—Constitutional. Struma, syphilis, acute specific fevers, as scarlet fever, measles, small pox, etc. One form is met with in old age (senile necrosis). The administration of mercury may produce this disease.—Local. These act by arresting the circulation in the region affected. Exposure to excessive heat or cold; severe concussion or injuries of the bone, without external wound; traumatic, from stripping of the periosteum. Phosphorous fumes produce necrosis of the lower jaw. Acute periostitis, ostitis and osteomyelitis. The bones chiefly attacked are the lower end of the femur, humerus, flat cranial bones, phalanges of the fingers from whitlow, lower jaw from phosphorous fumes, mercury, and syphilis.

Characters.—Necrosis is either superficial, internal, or total, according as the outer layer of the bone is affected, the portion next the medulla, or the entire thickness. The dead bone is termed a sequestrum; it is hard, brittle, sonorous when struck, painless, yellowish white, and does not bleed when incised or exposed. On exposure to the air it undergoes an alteration to a brown or black colour. The margins are rough, spiculated, the free surface smooth, and the attacked surface eroded, cribriform, or worm-eaten. If a long bone be

affected, the articular ends, as a rule, escape.

Symptoms differ according to the nature of the cause, and the extent of the bone affected. 1. Deep seated pain, with evening exacerbations; 2. Swelling of the limb; 3. Purplish redness of the skin, which has a glazed appearance; 4. Formation of large abscesses, with profuse suppuration, leaving sinuses, which lead to fistulous openings in the bone (cloacæ); 5. On passing as large a probe as possible through the cloaca, it touches the surface of the sequestrum, and this feels smooth and firm. The general symptoms are, in the early stages, those of inflammatory fever, later on, hectic and albuminuria.

Separation of the Dead Bone is effected in the same manner as in the separation of a slough during gangrene. The adjacent living bone takes on a process of inflammation, forming a line of demarcation, a granulation tissue and pus being formed; the sequestrum is loosened and also decreased in size from absorption by the granulations, and ultimately, these, by growing, expel the dead bone. It, on an average, occupies from three to ten months to detach the sequestrum, but the act is performed much quicker in the young than in the adult, and the superficial sequestra are more easily separated than the total or internal.

Process of Repair.—When the necrosis is superficial the neighbouring periosteum deposits new bone, the cavity in the old bone being filled by a fibrous tissue, which eventually ossifies, and is covered by a new periosteum, formed from granulation tissue. If internal, the inflamed periosteum produces osseous matter, thickening the outer layers of bone, in which openings (cloacæ) form for the expulsion of the sequestrum. Should the necrosis be total, the bone is re-formed, for the most part by the periosteum, which forms a shell of new bony tissue, external to the necrosed part, surrounding (invaginating) but not adhering to it; but in addition to the periosteum, the medulla, surrounding vascular tissues, epiphyses, and adjacent old bone, assist in the formation of new bone. In cases where the epiphyses are more or less involved, the process of repair is imperfect. The new bone is at first rough, porous, spongy, and very vascular, but gradually becomes compact and hard. It is at first larger

in circumference than the dead bone it replaces, but after a time contracts, the cloacæ closing, and the medullary canal, being lined with a new membrane, completes the process.

A rare form of necrosis, unaccompanied by suppuration, must be also mentioned, to which the attention of the profession has been directed by Marrant Baker. In the case reported by him, the whole shaft of the femur was necrosed and separated from the periosteal bone without the formation of any pus. He considers this the result of chronic inflammation, leading to the deposit of new bone, both periosteal and endosteal, thus cutting off the circulation from the already sclerosed bone (intraosseous necrosis). These cases resemble malignant disease, and the dead bone may be irremovable except by amputation.

Treatment.—Attend to any constitutional cause. Open abscess freely as soon as a diagnosis is made. Absolute rest is imperative. Remove dead bone when *completely separated, and not before*, a fact which is ascertained by the introduction of a probe through one of the cloacæ. If superficial, the removal is effected by making an incision through the soft parts and using forceps or an elevator. When internal, should the cloacæ be insufficient in size, they must be enlarged by the gouge or trephine, chisel, cutting pliers, or Hey's saw, and the bone be removed by necrosis forceps; the cavity must be filled loosely with lint sprinkled with iodoform, and hæmorrhage stopped by pressure. To prevent fracture, the limb must be put up in starch or plaster of Paris. Tonics, rest, and time, will complete the cure. If complete, subperiosteal resection must be resorted to.

Amputation is required: 1. If the patient's health is exhausted, and the necrosed bone so situated that it cannot be removed. 2. If the limb be much disorganised. 3. For wound of the popliteal artery by the sequestrum, with the patient in so weak a condition that an attempt at ligaturing the vessel would be useless. 4. In acute necrosis of the lower end of the femur, or the shaft of the tibia, implicating the neighbouring joints with large abscesses.

Osteo-malacia, or Mollities Ossium, is a very rare disease occurring only in adults, especially females. Durham

gives out of a total of 145 cases, 132 females, and but 13 males. The disease consists in a progressive softening of the bone, the result of an increase of the medullary tissue and destruction of the bony structure, the lime salts being absorbed from their organic constituents. The bones become so soft that they can be easily cut with a knife, and bend with facility. The medulla is much congested. On section the compact layer is found to be almost absent; the bone assuming a dark red colour, and consisting of a wide cancellous structure containing a reddish jelly-like fatty material, composed of granulation tissue, pigment granules, and blood corpuscles. This process proceeds until the whole of the interior of the bone is changed into the jelly-like material, with the exception of a thin layer of the cortex immediately subjacent to the periosteum. The vessels nearly always rupture, occasioning parenchymatous hæmorrhage. The nature of the affection is doubtful; the view most commonly received is that the change consists in a decalcification of osseous tissue spreading from the medulla and cancelli of the bone. Cysts are common, filled with an albuminous fluid and blood pigment, they obtain a membranous wall from fibrous degeneration of the decalcified bone and the organisation of the outer part of the medullary tissue. Fat is also present. The lime salts which have been removed from the bone are eliminated by the kidneys and appear in the urine; another substance met with in the urine is hydrated deut-oxide of albumen soluble in boiling water, its precipitate with nitric acid being dissolved by heat and re-forming when cold. The periosteum is unaffected.

Causes.—Repeated pregnancy, childbirth. Most frequent from twenty-five to thirty-five. Rheumatic tendency. Syphilis. If connected with pregnancy the disease commences in the pelvis and spine; in other cases in the lower extremities.

Symptoms.—Feeling of malaise; weakness in walking; deep-seated pains, worse at night and increased on pressure or motion. Emaciation and inability for exertion. Bending or breaking of bones from trivial causes. The bones most affected are the vertebræ, ribs, pelvis, and long bones. Death occurs

from exhaustion, and may be preceded by fever.

Diagnosis.—From rheumatism is at first impossible until the condition of the urine, fractures, and bending of bones take place. From rickets the disease is distinguished by the age, severe pain, great distortion, and spontaneous fractures.

Treatment.—Rest, warmth, lime salts, cod-liver oil, mineral acids, phosphates, tonics, and opium to relieve pain. Alum is also recommended. In extreme cases death is inevitable. Fractures should be treated as if union might take place, and on ordinary principles.

Rickets, or Rachitis, is a disease of early life, associated with malnutrition, and characterised by a change in the texture and form of the bones, accompanied by a deficiency of earthy matter.

Causes.—It is most common in large cities. All conditions which enfeeble the mother tend to give rise to rickets in the child. Frequent pregnancies, want of food, bad ventilation, any acute illness, chronic diseases, especially struma or tuberculosis, inherited syphilis, etc. With regard to the child, there is nearly always to be found on careful inquiry some defect in the quantity or quality of its food supply; this defect may be artificial feeding, particularly when farinaceous food is given; another constant error is administering cow's milk without sufficient dilution. In the case of women suckling their child, the latter is frequently kept on the breast far too long.

Pathological Anatomy.—The ends of the long bones are enlarged, and the flat bones thickened, particularly at their growing edges. The nature of the disease is uncertain, but it presents an increased growth with proliferation of the epiphyses and periosteal cells, accompanied by incomplete and irregular ossification. The transition layer of cartilage in which ossification normally proceeds is considerably widened, the adjacent layer of cancellous tissue being broader than usual. The line where calcification is proceeding is markedly irregular, as the bone shoots up at various parts into the cartilage. The transitional zone is never completely calcified, owing to the secondary cartilage capsules not being dissolved but becoming calcified, and thus isolating the cells contained in them, which are larger than bone corpuscles,

and have no canaliculi; thus a wide layer of imperfectly ossified soft tissue (spongeoid tissue) is formed at the growing end of the bone. Similarly the periosteal ossification is distinguished by a widening of the transitional layer and irregular and incomplete ossification, the bone being covered with a soft, thick, vascular structure (osteoid tissue). The medulla of the cancellous bone, Haversian canals of the compact tissue, and in the osteoid tissue is condensed and fibrillates, whilst the bony spaces containing it widen from absorption of their walls, producing great softening and weakening of the bone.

The chemical changes consist in a marked increase in the organic matter of the bone with decrease in the inorganic matter from diminished quantity of earthy salts.

Symptoms.—1. Sweating about the head and chest, especially during sleep. 2. General soreness and tenderness of the body. 3. Throwing off the bed clothes at night. 4. Fetid stools, restlessness and variable appetite are early symptoms. Later on the bone changes appear, the head is large and expanded, the forehead projecting, and the fontanelles unclosed. A condition noticed by Elsässer is frequently present in the skull between the third and fifth months; this consists in thinning and softening of the parietal and occipital bones (craniotabes), the bone yielding under pressure of the finger. The face is small and old looking. The teeth being very late in appearing, owing to arrest of growth, with deficient enamel they soon begin to decay; occasionally dentition is irregular, but not late. Sir William Jenner writes: "If you fail to look for rickets, you will most likely attribute to the irritation of teething symptoms which are the consequence of the rickety diathesis." The limbs are curved, generally symmetrically, especially the tibiæ at the lower third, the curve being outwards and forwards, but the femur and humerus may also present deformity. The pelvis is contracted, assuming a trefoil-shape, from displacement forwards of the sacral promontory and inwards of the acetabula. The epiphyses are enlarged, especially the wrists and ankles. The chest is narrow above and expanded below, and a rosary of nodules is felt along each side at the junction of the ribs

and cartilages, the sternum is prominent and the sides flattened. There may be angular curvature, but this is rare. All the ligaments are relaxed and loose, thus as puberty advances, lateral curvature may occur, and knock-knee or club foot may be early recognisable. Under two years of age, convulsive symptoms are most frequent, so much so that in all convulsive attacks occurring in children rickets should be suspected and looked for. The general symptoms are emaciation and weakness, arrest of growth, and derangement of the alimentary canal. The abdomen is tumid and large, because: 1. The chest is smaller and the diaphragm more depressed than in health; 2. The liver and spleen are often larger than natural; 3. The capacity of the pelvis is diminished; 4. The muscles of the abdomen and intestines are less powerful than they are in their normal condition, and the derangement of digestion favours the formation of flatus (Sir William Jenner).

In the first few months of life, children, the subjects of this disease, are prone to suffer from catarrhal affections of the respiratory and digestive organs. Another affection almost confined to rickets is laryngismus stridulus. The spleen, liver, and lymphatic glands, may be enlarged from increase of interstitial tissue.

Cause of Death.—1. General cachexia. 2. Catarrh and bronchitis. 3. Albuminoid infiltration of organs, especially the lymphatic glands and the spleen. 4. Laryngismus stridulus. 5. Chronic hydrocephalus. 6. Convulsions. 7. Diarrhoea (Noble Smith). In most cases the deformities disappear as the patient grows older, but the chest and pelvis are often permanently affected.

Treatment.—Attend to the diet, which must be good in quantity and quality. Peptonised milk is excellent for young children, but the best article of diet is fresh arterial blood from the bullock's heart, which may be mixed with milk in the proportion of one tablespoonful to a bottle of milk (*vide* inherited syphilis). Pure air is essential and warm clothing, not only of the body, but also the limbs. The child's sleeping apartment should be warmed by a fire, and the nursery should be as far away as possible from the basement of the house. It is highly important to attend to the digestive organs by small

doses of hydrarg. e. creta, combined with bicarbonate of soda. The child must not walk or stand much, but use a hand chair; the deformities, unless very pronounced, may be left alone, but if necessary the limbs must be supported by properly applied splints. Friction with warm sea-water is useful. Cod-liver oil given just after food, and continued for some time, is most powerful in combating this disease, if it cause diarrhoea give mass of opium with each dose. Vin. ferri is also of use. If fracture occur, and in this affection spontaneous fracture is not uncommon, treat on ordinary principles, as the broken ends soon unite. The limbs of rickety children are often very cold, with a languid circulation; a very weak, continuous current from a galvanic battery is of service in this condition.

Ostitis Deformans (Paget) affects most frequently the long bones of the lower extremities, the clavicle, and the skull; it is usually symmetrical.

Pathology.—The bones present the consequences of inflammation affecting in the skull the whole thickness, but in the long bones only the compact tissue. The earliest changes are inflammatory, the bone being rarified and softened, associated with enlargement, and the excessive production of imperfectly developed structures and increased blood supply. At the termination of this process there is a marked increase in density, so that the medullary canal of a hollow bone is obliterated, whilst in the skull the diploë are filled in, and the tables thickened. The surface of the bone is roughened from periosteal ossification.

Causes are unknown, but it appears to be a chronic ostitis affecting the osseous system in general.

Symptoms.—It begins in middle life or later, and is very slow in its progress. The most characteristic symptoms "are the loss of height, indicated by the low position of the hands when the arms are hanging down; the low stooping with very rounded shoulders, and the head far forwards with the chin raised, as if to clear the upper edge of the sternum; the chest sunken towards the pelvis, the abdomen pendulous; the curved lower limbs, held apart, and usually with one advanced in front of the other, and with both knees slightly bent; the ankles overhung by the legs, and the toes turned out." The vault of the skull is

enlarged, and the upper part of the spine is curved and fixed in this position, so that the ribs are crowded together. The shafts of the long bones are enlarged and abnormally bent; but, however much distorted, are able to support the weight of the trunk. The general health is not affected or the mental powers. Life is not materially shortened. In some cases cancer may follow.

Treatment.—None is of any use.

Tumours of Bone.—Exostoses and enchondromata have been sufficiently described in chap. ix.

Sarcomata of Bone are the most important tumours met with in connexion with the osseous tissue. In many cases a history of some injury precedes the appearance of the growth. These tumours are divided according to the part from which they start, into: 1. Interstitial or central; 2. Periosteal or peripheral; 3. Infiltrated (rare).

In the interstitial the growth springs from the medullary canal at or about the articular ends, in the form of whitish scattered nodules, which coalesce, expanding the bone as a shell. As it nears the surface, the irritated periosteum produces new bone, encapsuling the growth, and serving as a distinguishing mark from the peripheral variety. It is liable to degenerative changes, and often exceedingly vascular. The disease is never localised, but affects the whole bone. In the periosteal form, the bone is not so completely invaded; the tumour develops generally from the osteogenetic layer of the periosteum, and is very prone to be ossified or calcified. It is often traversed by osseous rays, starting from the subjacent bone; these rays are due to formation of bone round the vessels, running from the periosteum at right angles to the bone. Bone is never developed on the outer surface of the tumour or the capsule.

The infiltrated form is uncommon, the whole bone being converted into a sarcomatous mass.

Kinds.—Round-celled, spindle-celled, mixed-celled, and myeloid. Cartilage or cysts may be conjoined.

Seats.—All the long and many of the flat bones may be affected, but the lower end of the femur, head of the tibia, fibula, and head of the humerus are the favourite positions.

Symptoms.—Sarcoma of bone gener-

ally occurs before the age of thirty, and may appear in very early life. Acute, darting, lancinating pains, rapid increase in size of the part affected of a spherical shape when central, and covered with bony plates, which may give rise to "egg-shell crackling": when periosteal, the form is long and fusiform or pyriform, smooth or knotty, but without osseous covering. The skin is at first pale and covered with distended veins, but becomes eventually implicated. Spontaneous fracture at the diseased site may take place. When interstitial, the progress is at first slow, as long as the disease is kept within its bony cavity, but when it bursts forth it develops with alarming rapidity. In some cases pulsation, a thrill or blowing murmur is apparent in the central tumours. The cartilage of the joint is seldom implicated, being pushed forwards by the growing mass. Secondary ossifying growths are prone to occur in the internal organs, especially the lungs.

Diagnosis.—From non-malignant growths by the following characters: 1. Occurrence in early life, before thirty. 2. Extreme pain. 3. Rapid growth—if the tumour has doubled its size in six months, and is not inflamed, it is very likely to be sarcomatous; if the tumour has existed on or in the bone for two or more years, it is probably not sarcomatous. 4. An elastic, tense, diffused pulpiness on palpation, with semi-fluctuating points. 5. Enlargement of veins. 6. Impairment of the general health. 7. A tumour in the shaft of any bone, but a phalanx, is rarely innocent, and so are any but cartilaginous growths on the pelvis, or any but hard bony tumours on the bones of the skull. From aneurism (see that disease).

Treatment.—Amputation at or above the next joint, and, if possible, above the origin of the muscles inserted into the part of the bone affected. Excision in the case of the bones of the face, if the disease be limited.

Cystic Tumours of Bone.—1. Those occurring in connection with the jaws and dependent on the teeth. 2. Those accompanying some other growth, as enchondroma, or central sarcoma. 3. Simple fluid cysts. 4. Hydatid cysts, the cystic tumours containing the entozoa.

Treatment.—Of first variety (*vide* diseases of the jaw); of the second is

that of accompanying growth; of the third and fourth, removing cyst wall with the trephine, stuffing it with lint and iodoform, and allowing it to granulate.

Curcinoma of Bone, as a primary disease, is almost unknown, but as a secondary growth may develop in the cancellous tissue of almost any bone. Epithelioma of the jaws is common, but arises from the adjacent mucous membrane.

Osteo-Aneurism, or Pulsating Tumour of Bone, is a term applied to three conditions: 1. Development of large numbers of new and dilated vessels in a sarcoma of bone; 2. Vascular erectile growth, resembling a nævus; 3. Formation of a cavity in the bone, filled with blood, and having arterial branches freely opening into it.

Seat.—Articular ends of the long bones, tibia, radius, humerus, and femur. Pelvic bones, skull, and ribs.

Symptoms of the second and third. An oval, elastic, slow growing tumour, not implicating the skin, having distinct pulsation, and a bruit which vanishes on compressing the main artery. The bruit may be absent in the third form, which possesses a bony margin.

From aneurism, the chief diagnostic signs are the site of the tumour, fixation to the bone, indefinite outline, and presence of egg-shell crackling.

Treatment.—If extensive, amputate; or if associated with sarcoma. Ligature and compression of the main artery may be tried in non-malignant cases.

CHAPTER XIV.

INJURIES TO JOINTS.

Sprains—Wounds—Dislocations.

Sprains or Strains are very common accidents, due to violence, as falls, etc., causing a wrench of a joint. The articulations most prone to be thus affected are the ankle, wrist, hip, vertebræ, and knee. The skin is usually unbroken, but the parts around the joint are severely bruised, torn, or stretched. There is often effusion of blood, from laceration or distension of the vessels, into the adjacent cellular tissue; the fibres of the ligaments and tendons are more or less torn.

Symptoms.—Rapid swelling from extravasation of blood and effusion in the joint. Intense pain. Loss of function. Ecchymosis appearing after a day or two, and extending some distance above and below the joint. The effects of a sprain may last a life-time, the part injured being painful and swelling on the least violence or exposure to cold, etc., or a chronic inflammation may develop, which will lead to serious disease of the joint. Stiffness and even ankylosis may be permanent.

Treatment.—If the case be seen early, cold, applied by ice poultices, ice packing, or Leiter's coils for two or three days. If there be much swelling, and some time has elapsed since the accident, heat is most grateful to the patient. Sayre

recommends immersion of the limb in water of as high a temperature as can be borne, gradually increasing the temperature, and maintaining this for several hours until the pain has subsided. Sponges wrung out of hot water are useful. The next step consists in immobilisation and compression by moistened millboard splints, starch bandage, plaster of Paris, etc. As soon as the swelling and acute pain have disappeared, movements of the joint should be practised with massage, rubbing oil or stimulating liniments into the injured seat. Alternate hot and cold douches to the part. Flying blisters. Faradisation. Should the joint be fixed by adhesions, these must be broken down under an anæsthetic, the joint being made to perform its natural movements with steady continued force, *provided all unnatural heat has left the articulation*.

Wounds of Joints may be incised, punctured, or lacerated.

Symptoms.—Effusion of transparent, viscid, sticky synovial fluid, which when rubbed can be drawn out between the fingers into long threads; if the joint be moved this fluid escapes more freely. These wounds are apt to be followed by suppurative arthritis. If there be any

doubt whether the joint be opened or not, treat it as a wounded joint, and on no account pass a probe into the wound.

Treatment.—Strict aseptic measures, remove any foreign body, as a needle, insert drainage tube, and rest the joint by the application of a splint. The diet must be light at first and gradually increased. Opium or atropo-morphia hypodermically is essential. Calomel and vin. antimon. are of service. Should suppuration ensue, the joint must be freely opened and washed out daily with an antiseptic; of course complete rest is necessary, both general and local, by fixing the limb on a splint. If the knee joint be suppurating, anæsthetise the patient, and freely drain the joint by eight drainage tubes: one on either side of the bursa; one on either side of the suprapatellar synovial expansion; one on either side of the condyles, about an inch above the semilunar cartilages, near the posterior part of the joint where the synovial sac is reflected; and one on either side of the ligamentum patellæ.

Abscess in proximity to a wounded joint.—"When the capsular ligament becomes inflamed the formation of abscesses, attended with a high degree of fever and ultimately a stiffness of the joint, are common consequences if the life of the patient is preserved" (Hey). These must be freely opened.

Dislocations.—By dislocation is understood a sudden and forcible displacement and separation of the contiguous surfaces of an articulation. The bone nearest the trunk is considered to be the fixed one, and that more remote the dislocated one. These injuries are divided into: 1. Complete, when the articular surfaces are wholly removed one from the other. 2. Partial or incomplete, when the bones still touch, although not in their usual position. 3. Simple, when unaccompanied by any more serious injury than a rupture of the ligaments and muscles. 4. Compound, that is, with a wound communicating with the articulation. 5. Complicated, when some other injury, as fracture, or laceration of important vessels or nerves, etc., is superadded. Other varieties are spontaneous, in which the dislocation is not caused by external violence, and congenital.

Causes.—Predisposing. Form of a joint: ball and socket joints being more liable to this accident, from their wide

range of movement. Age: dislocations being rare in childhood and old age. Sex: men being much more often affected than females. Alterations of the articulation, the result of disease or fracture of an articulating cavity. Previous dislocations. Muscular weakness.—Exciting. External violence, either directly applied to the joint, or, as is more commonly the case, acting at a distance. Muscular action, as exemplified by dislocation of the lower jaw in gaping.

Symptoms.—1. Shortening (or in two cases lengthening) of the limb. 2. Im-mobility when motion of the joint is attempted, either voluntarily, or by the surgeon. 3. Change in the shape of the joint and position of its bony processes. 4. Alteration in the axis of the limb. 5. Pain and numbness. 6. Presence of the head of the bone in a new position, and absence in the normal.

Always compare the sound side with the injured, and administer an anæsthetic in doubtful cases.

Effects.—The muscles and ligaments round the joint are torn or stretched. Bones may be fractured and cartilage injured. The capsule is ruptured in the direction in which the bone is displaced, and the vessels and nerves compressed. If the accident is not reduced, various changes take place; in orbicular joints the orbicular cavity flattens and becomes contracted in adults, but in children is filled by a fibrous tissue. In hinge joints the articular ends become rounded off and flattened. The enveloping cartilage is absorbed, ligaments atrophied and shortened, whilst where the displaced bone rests a false joint is formed. This occurs either from the adjacent bone being hollowed into a cavity, or a zone of callus being deposited and acting as a cup; at the same time the surrounding connective tissue is thickened and serves as a capsule. Hamilton has pointed out that the great vessels sometimes become adherent to the capsule or periosteum of the displaced bone, and if attempts are made to reduce it, fatal hæmorrhage may result.

Treatment, which should be commenced as soon as possible after the injury, consists in replacing the bone (reduction). The obstacles to this are: 1. Entanglement of the displaced bone with its neighbour. 2. Contraction of the muscles. 3. Resistance of untorn portions of the capsule. The means

adopted are manipulation, extension, and counter-extension, to overcome the first and third difficulties, and chloroform to obviate the second.

Manipulation or manœuvring consists in studying the position of the displaced bone, and by movements of flexion, extension, rotation, etc., bringing the bone back into its socket. Extension and counter-extension are employed by fixing the patient's body and articular cavity with a split sheet, jack towel, padded belt, etc., fastened to the bed-post or wall; and applying force to the displaced limb by the hand, towel applied in a clove hitch, or pulleys fastened to the lower part of the bone affected.

After-treatment.—The recurrence of displacement must be prevented by bandages, splints, and rest. Inflammation is limited and subdued by the application of cold. Pain is subdued by full doses of opium, or atropo-morphia, hypodermically. The function of the joint must be re-established by passive motion commencing two or three weeks after the injury, which will prevent the formation of adhesions. If these occur the patient should be anæsthetised and the limb forcibly manipulated until the joint is freely movable. An articulation once dislocated is rarely restored to its pristine condition, but ever after presents some weakness, defect of movement, or perverted sensibility.

The latest time at which a dislocation can be reduced varies with the joint. As a general rule, the hip and shoulder cannot be replaced after three months; hinge joints after the expiration of one month. There have been many exceptions to this rule, but the surgeon must remember that serious and irreparable mischief has been produced in attempting the reduction of old dislocations, without relieving the patient. In recent dislocations the bone returns with a distinct thud, but in cases of long standing this does not occur. Gross writes, "If the joint is very stiff and tender, if the luxated head has contracted firm adhesions, involving perhaps a large artery or some other important structure, and, if in addition to this, there is reason to believe the socket is filled up with new matter, any efforts at reduction would not only prove abortive, but might be followed by very serious accidents, jeopardising limb and life."

In reducing chronic dislocations considerable force must be used in order to break down adhesions, free rotation being resorted to; chloroform should always be given. Continuous extension for days by the weight and pulley, or india-rubber accumulators, applied in the axis of the displaced bone, is of immense service, and far safer than forcible replacement; the head of the bone when lodged over the spot it should normally occupy will cause absorption of any intervening structure, as capsular, ligamentous, fibrous, or muscular tissue. In some cases subcutaneous section of muscles is necessary. After reduction, the ice bag, or Leiter's coils, should be applied to the joint.

The untoward events which are liable to occur in attempting reduction of old dislocations, are: 1. Laceration of the skin by the pressure of the extending bands. 2. Laceration of the muscles. 3. Subsequent inflammation and suppuration of the joint, with perhaps the onset of pyæmia. 4. Extravasation of blood from the rupture of small vessels. 5. Rupture of a large vein. 6. Rupture of an artery. 7. Laceration of adjacent nerves. 8. Fracture of the dislocated bone. 9. Fracture of neighbouring bones. 10. Avulsion of the limb (very rare). In consequence of the chance of these disasters, caution must be used, and passive motion, friction, and douches tried, should an attempt at reduction be thought inexpedient. If the limb can be moved in the new position without much pain it is better left alone.

Complicated Dislocations.—1. Fracture of the shaft, combined with dislocation of the head of a bone, must be treated by firmly putting up the fractured bone in splints, and effecting reduction under chloroform. 2. Compound dislocation, with fracture of the articular ends, demands removal of splinters and partial resection, or amputation, in accordance with the severity of the injury.

Compound Dislocation is a very severe injury, attended by much danger, being apt to be followed by acute traumatic arthritis, abscesses, pyæmia, erysipelas, tetanus, necrosis, hæmorrhage, etc. This accident is most common at the ankle joint.

Treatment.—Try to obtain union by first intention. Aseptic method is very useful both in compound dislocations

and fractures. The joint is thoroughly washed out with 1 in 20 carbolic lotion by means of a syringe and catheter, the wound being enlarged if necessary. The skin surrounding the wound is washed well with the same lotion, a drainage tube is introduced, and a large gauze dressing applied under the spray. A splint is then fixed to the limb. If the case be not seen until twenty-four or thirty-six hours, 1 part of carbolic acid to 5 of methylated spirit is used to wash out the joint. If still later, chloride of zinc (gr. xl to ʒj), or iodoform in alcohol and water. If the aseptic mode cannot be adopted; in the case of a small joint, reduce the dislocation and use constant irrigation with cold water. Should the upper extremity be the seat of the injury, the patient healthy, and the soft parts not much damaged, reduce the bone, and use cold irrigation to subdue the inflammation. For the lower extremity, in the case of the knee amputation is often necessary, but for the ankle and astragalus an attempt to save the limb must be made, the joint being placed in a state of absolute rest by splints, plaster of Paris bandage, etc. Stiffness remains for an indefinite period after a compound dislocation.

Particular Dislocations.—*Lower jaw* is always dislocated forwards unless there be a fracture of the temporal bone. This dislocation is most commonly met with from twenty-five to thirty-five years of age, and is very rare in children.

Causes.—Sudden contraction of the depressor muscles in opening the mouth widely during laughing, shouting, gaping, singing, vomiting, puerperal convulsions, or attempting to bite a large apple. It may also be produced by blows on the opened jaw, or the introduction of the stomach pump, or using the elevator too violently in extracting teeth, and also in taking models of the lower jaw.

Displacement.—When the lower jaw is much depressed the condyles move forwards, carrying with them the inter-articular cartilages and rising on the eminentiæ articulares. In this position the insertion of a part of the fibres of the masseter muscle is carried backwards, and these fibres are put on the stretch, with the anterior fibres of the temporal muscles. If the depression of the jaw is increased the condyle

ruptures the capsule and is pulled forwards into the zygomatic fossa by the external pterygoid muscle and the tense fibres of the masseter and temporal muscles. The coronoid process lies surrounded by the temporal muscle behind and below the malar process. The fibro-cartilage follows the condyle. The capsule is stretched, the external lateral ligament tense, passing from behind forwards, and the internal lateral and stylo-maxillary ligaments also stretched. Both masseters, internal pterygoids, and temporals are strained or torn.

Symptoms differ in accordance with the accident being single or bilateral.

When Bilateral.—1. Mouth is wide open and fixed. 2. Deglutition and speech impaired. 3. Dribbling of the saliva. 4. Condyles are felt lower and anterior to their normal position. 5. Depression in front of meatus auditorius. 6. Lower teeth advanced half an inch beyond the upper. 7. Angle of the jaw closer to the mastoid process than it should be.

When Unilateral.—The axis of the jaw is directed to the opposite or healthy side and the depression very well marked, the other symptoms, though less pronounced, are similar to the bilateral form.

Treatment.—Put the thumbs, well protected by a napkin, as far back along the alveolar edge as possible, forcibly depress the bone, at the same time raising the chin, then the bone returns with a forcible snap. In all cases an anæsthetic is of great assistance. Nélaton used depression of the chin and pressure on the coronoid process from before backwards. In difficult cases corks or wooden levers may be used instead of the surgeon's thumbs. Apply a four-tailed bandage and order a spoon diet for a fortnight. Such dislocations are apt to recur. In old cases Stromeier's forceps will give the necessary leverage. Nélaton advised direct pressure on the coronoid process, and Pollock gets pressure on the chin by means of a Petit's tourniquet fixed upon the head, wedges being introduced between the teeth. When the luxation remains unreduced, the jaw in the course of time recovers a considerable degree of movement, and the teeth approximate.

Clavicle is rarely dislocated, but from falls on the shoulder or arm, either the sternal or acromial end may be displaced, or even both ends simultaneously. Sterno-clavicular dislocations are of three kinds: 1. Forwards. The capsular, anterior, and posterior sterno-clavicular ligaments, and rhomboid ligament are torn. Interarticular cartilage may or may not accompany the clavicle.

Symptoms.—The end of the bone can be felt in its new position, where it forms a swelling in front of the upper part of the sternum. There is a depression at the natural situation of the joint. The shoulder is brought nearer the middle line, and depressed, and the fossæ above and below the clavicle are well defined. The head is drawn forwards and turned from the affected side, to relax the fibres of the sterno-mastoid muscle, the inner portion of which is unusually prominent. The bone retains its normal length. Inability to raise the arm.

Treatment.—Draw back the shoulder whilst pressing the spine with the knee. A compress over the end of the clavicle, fixed by a figure of 8 bandage, and a sling for the arm, with a pad in the axilla. This apparatus is kept on for five to seven weeks, and then a sling is used for the arm during two weeks. The dislocation is exceedingly difficult to retain in position, in fact this is often only approximately possible, but the usefulness of the arm remains.

2. Upwards is very rare. The distance between the two clavicles is diminished, and the bone easily detected in its new position above the top of the sternum. The axis of the clavicle is directed forwards and upwards, and separated from the first rib. The sternal origin of the sterno-mastoid is tense and rigid, being stretched over the end of the displaced bone. The shoulder sinks forwards and downwards, approaching nearer the middle line than natural.

Treatment.—To effect reduction place a large pad in the axilla and press the elbow to the side, whilst direct pressure downwards is made on the displaced end of the bone. A bandage and pad, with a sling catching the elbow. The scapulæ should be firmly fixed by strapping. Supine position.

3. Backwards. The distance from the shoulder to the breast is lessened, the

bone is felt in its new position behind the sternum, and there is a depression over the position of the sternal end of the clavicle. The head is inclined towards the sound side. By the pressure of the bone on the trachea, œsophagus, and great blood vessels, various symptoms are produced, as difficulty in breathing, cerebral congestion, etc.

Treatment.—To reduce the dislocation put the clenched hand in the axilla, drawing the elbow to the side whilst an assistant draws back the shoulder, pressing on the spine with his knee. A figure of 8 bandage round the shoulder and over a pad in the middle of the back will support the part, or a splint passed behind the shoulders, with a pad between it and the spine, the shoulders being drawn to the splint by a bandage. Should these means be irksome, the patient must assume the horizontal position on a hard mattress, with the head resting on a low pillow, and the arms crossed on the chest.

Acromio-Clavicular end is sometimes dislocated, the outer end of the collar-bone slipping outwards and backwards over the acromion process. This would be better termed dislocation downwards of the scapula.

Causes.—Falls or blows on the clavicle or acromion process. The arm being suddenly drawn forwards over the head.

Symptoms.—Shortening from the sternum to the shoulder; the end of the bone being easily felt in its new position by tracing the spine of the scapula from within outwards. The trapezius muscle is unusually prominent. Movements of the arm upwards are limited and painful. The deltoid is flattened from the arm falling or being pushed downwards, and the arm thus appears lengthened. The head is inclined towards the affected side.

Treatment.—Draw the shoulder upwards and backwards, whilst pressing with the knee on the spine; figure of 8 bandage round the shoulder and back, with a pad on the acromial end of the clavicle. Forearm must be flexed and fastened to the side.

Dislocations under the acromion and under the coracoid process are easily recognised, and treated as above; they are very uncommon. Simultaneous dislocation of both ends of the clavicle has been met with.

In dislocations of either extremity of the clavicle, when treated on the best methods and by the most experienced surgeons, some deformity always remains, but the patient will recover the use of his arm; in bad cases it might be worth while connecting the articular extremity by silver wire passed subcutaneously, as proposed by Gross.

Shoulder Joint can be dislocated in four directions: 1. Forwards and inwards, or subcoracoid (most common); 2. Forwards and to the inner side of the coracoid process, or subclavicular; 3. Downwards and inwards, or subglenoid; 4. Backwards, beneath the spine of the scapula or the posterior edge of the acromion, termed subspinosus.

1. *Subcoracoid*.—In this dislocation the head of the humerus is thrown forwards and inwards either directly or with an inclination downwards as well, and rests on the anterior surface of the neck of the scapula and border of the glenoid, below the coracoid process.

Symptoms.—1. Shortening only slight in degree, from the pectoralis major and deltoid, drawing the head of the bone upwards; occasionally there may be a trifling increase in length. 2. The elbow is projected from the side and thrown backwards. 3. The acromion projects with great distinctness, and there is a hollow below it, thus giving an angular appearance to the shoulder. 4. On elevating the elbow and rotating the arm the head can be felt at the upper and inner part of the axilla, where it is covered by the pectorals and coraco-brachialis muscles. 5. Limitation of both voluntary and passive motion. 6. Callaway's test, or increased vertical measurement. In recent dislocations, on measuring with a tape passed under the axilla and over the acromion, the injured side is two inches larger than the sound. 7. Dugas' test: With the elbow touching the side the fingers of the dislocated limb cannot touch the sound shoulder. 8. Hamilton's test: A straight stick or ruler will touch the acromion, and at the same time the elbow of the injured side. In a healthy limb it will be half an inch or more from the acromion. 9. Range of movement test. In dislocation the range of movement is so much impaired that it is impossible to bring the hand to the back of the head. 10. Great pain from pressure on the nerves.

2. *Subclavicular, or Intra-coracoid* (Nélaton) is merely an exaggerated stage of the preceding variety. The head being carried to the sternal side of the coracoid process, and resting on the 2nd and 3rd ribs beneath the pectorals and immediately below the clavicle. The anterior and inner parts of the capsular ligament are much ruptured; the supra- and infraspinatus muscles, and portions of the deltoid arising from the acromion and spine of the scapula, together with the inner fibres of the coraco-brachialis, and short head and long tendon of the biceps, are extensively stretched or lacerated. The subscapularis is carried upwards. In some cases the tuberosities are fractured. The axillary vessels and nerves are severely pressed.

Symptoms.—1. Shortening. 2. Elbow much projected and thrown backwards. 3. Projection of and hollow under the acromion. 4. Head of the humerus occupies the space between the deltoid and pectoral muscles, and can be felt there on rotating the limb. 5. Axis of the arm is directed inside its proper position. 7. Callaway's, Dugas', Hamilton's, and range of movement tests are all apparent.

3. *Subglenoid* is next in frequency to the subcoracoid. In this form the head of the bone rests against the inferior costa of the scapula over the origin of the long head of the triceps. The subscapular muscle is torn through, usually at its insertion. The supraspinatus may also be ruptured and the other capsular muscles stretched. The axillary blood vessels and nerves suffer from pressure, and the deltoid may be paralysed from damage to the circumflex nerve.

Symptoms.—1. Lengthening of the limb (1 inch). 2. Elbow thrown out from the side and carried backwards, but can be brought down with difficulty, converting the injury into the subcoracoid form. 3. Projection of, and a hollow under, the acromion. 4. Depression of the anterior fold of the axilla, with the nipple at a lower level than the sound side. 5. On raising the elbow, the head can be felt in the axilla. 6. Forearm is bent, supinated, and often supported by the patient. 7. Movement of the shoulder is very limited and painful. 8. Severe numbing pain in the hand and arm, with absence or feebleness of pulsation at the wrist from pressure of the head of the bone on the nerves and artery. 9. The distance be-

tween the coracoid and the head of the bone one to two inches. 10. Callaway's, Dugas', Hamilton's, and range of movement tests are present.

4. *Subspinous*.—In this dislocation the head lies below the spine of the scapula, or more commonly upon the back of the neck of the scapula, or the edge of the glenoid cavity just below the posterior angle of the acromion. The posterior aspect of the capsule is torn, and the subscapularis, teres minor, long head of the triceps, infra- and supraspinatus muscles lacerated.

Symptoms.—1. Shortening, but this is usually slight. 2. Elbow thrown forward and raised from the side, to which it cannot be brought down. 3. Projection of, and hollow under, the acromion. 4. Coracoid process very prominent, and covered with tightly stretched skin. 5. The head can be felt in its new position on rotating the arm. 6. The axis of the limb is directed nearly horizontally backwards. 7. The axilla loses its fulness, and if seen early, the finger will sink into the vacant glenoid cavity. 8. Callaway's, Dugas', Hamilton's, and range of movement tests are apparent.

Causes.—Dislocation of the shoulder is usually the result of falls on the hand or elbow, the variety occurring being due to the direction of the force and the position of the limb at the time of the accident. It may be caused by direct violence, and, as a rare event, by muscular action. If a person falls with his arms widely stretched out, the head of the bone is driven against the lower and inner part of the capsule, and a subglenoid dislocation results; this may either remain a subglenoid, or the muscles may pull the head of the bone into some other situation. If the patient fall on his elbow, the head is thrown upwards and forwards, producing the subcoracoid, or subclavicular forms, which are also often the consequence of direct violence to the shoulder. The subspinous occurs when the force is applied to the arm, when it is raised and stretched out in front of the body. Shoulder dislocations are most common in adults of the male sex, and rare below fifteen; the youngest case I have met with was a little girl aged two years, the injury being well marked.

Frequency.—The subcoracoid is most common, then the subglenoid, and the

rarest forms are the subclavicular and the subspinous.

Diagnosis.—From fracture of the neck of the humerus, dislocation is distinguished by the absence of crepitus, displacement of the head of the bone, sharpness of the angle of the shoulder, alteration in the axis of the limb, projection of the elbow from the side, and limitation of the movement. Paralysis of the deltoid is distinguished from dislocation by there being no limitation of movement, or displacement of the head of the bone in this condition.

The table, given on page 96, copied from Southam's excellent work on Regional Surgery, clearly shows the main points of difference between the varieties of dislocation.

Treatment.—1. Extension methods. (a) By the surgeon's stockinged heel in the axilla. The patient resting on his back on a couch, the surgeon draws the arm downwards parallel with the body, and then adducts the arm across the patient's trunk. (β) By the knee in the axilla (Astley Cooper). The patient sits up, and the surgeon standing behind supports his foot upon the edge of a chair and inserts his knee into the axilla, the dislocated bone is placed over the knee and forced downwards and inwards. (γ) Simple extension with pulleys or assistants. (δ) Upward extension. The arm is raised outwards, upwards and backwards, until parallel with the patient's head, the scapula being steadied by the surgeon's hand, or better by his foot, the patient being on the floor. Extension is made from the wrist, and it is advisable to rotate the humerus as it nears the glenoid cavity. (ε) Right angle extension. The arm being abducted until at a right angle with the trunk, and then extension made directly away from the body, whilst an assistant steadies the scapula. (ζ) Flower's method of extension. The patient is seated on a high chair, which is placed about two feet from an open doorway. The surgeon having his back against the doorpost, places one foot upon the side of the chair, and, with his knee pressed into the axilla, and both hands upon the shoulder, steadies the patient's body. A jack towel is then fixed by a clove hitch to the patient's arm just above the elbow, and by this means two or more assistants, placed on the other side of the door,

SYMPTOMS.	SUBCORACOID.	SUBGLENOID.	SUBSPINOUS.	SUBCLAVICULAR.
Appearance of shoulder.	Flattened especially behind.	Flattened generally.	Flattened especially in front.	Flattened especially behind.
Projection of the acromion.	Well marked.	Well marked, more so than in subcoracoid.	Well marked.	Well marked.
Depression beneath the clavicle.	Replaced by a projection, viz., the head of the humerus.	Preserved.	Preserved.	Replaced by a projection, viz., head of the humerus.
Position of the head of the humerus.	Beneath the coracoid process.	In the axilla beneath the glenoid cavity.	On dorsum of the scapula beneath the spine.	Beneath the clavicle on the inner side of the coracoid process.
Length of the arm.	May be unaltered, increased, or diminished.	Increased.	Unaltered or slightly increased.	Usually diminished.
Anterior fold of the axilla.	Fuller than usual.	Deeper than usual.	Marked by a depression.	Fuller than usual.
Position of the elbow.	Separated from the body and directed slightly backwards.	Separated from the body (more so than in the subcoracoid) and directed slightly backwards.	Directed forwards, the arm resting against the side and lying across the chest.	Directed backwards and away from the body.
Axis of the humerus (from below upwards).	Directed forwards and inwards to a point internal and anterior to the glenoid cavity.	Directed downwards and slightly forwards to a point below the glenoid cavity.	Directed backwards.	Directed forwards and more inwards than in subcoracoid.

make steady extension vertically outwards.

2. Manipulation with the patient under chloroform. (a) The surgeon in subglenoid or subcoracoid places the thumb of one hand over the head of the bone and the fingers over the spine of the scapula, and with the other hand seizes the forearm below the flexed elbow. The movements are extension and rotation outwards, abduction and rotation inwards, with the limb brought suddenly to the side of the chest. In the subspinous form, the surgeon stands behind the patient and grasps the axilla from behind. The movements are extension, drawing elbow backwards, and rotation outwards. (β) Kocher's method. The patient sitting, grasp the elbow of the injured limb with the forearm flexed at a right angle, press the elbow to the side and rotate outwards as far as possible, carry the elbow forwards and inwards towards the middle line of the body, over but away from the chest, and suddenly rotate the arm inwards bringing it down to the side. I have used all these methods of reduction, but prefer Kocher's method by manipulation, and, if unsuccessful, upward extension. Chloroform is a great aid in all difficult cases.

After-treatment consists in bandaging the arm to the side, and supporting the elbow by a sling for a fortnight.

Compound Dislocation.—If the axillary vessels and nerves be uninjured the bone is to be replaced and the wound dressed aseptically; should these vessels be implicated, amputation at the shoulder is necessary.

Complications.—1. Dislocation with fracture of the acromion, neck of the scapula, or shaft of the humerus, is treated by reducing the dislocation, putting up the fracture temporarily if necessary, and then treating the fracture. 2. Dislocation with laceration of the axillary artery and the formation of a diffuse traumatic aneurism demands ligature of the subclavian immediately after the dislocation is reduced. Old dislocations, when of a few weeks' standing, may be reduced under chloroform, but this is not to be lightly undertaken, as stated elsewhere.

Dislocations of the shoulder, in spite of the most skilful treatment, are apt to be followed by atrophy of the deltoid and more or less rigidity of the articulation.

Dislocations of the Elbow are common in young persons.

Causes.—Violent force applied to the hand whilst the forearm is flexed on the arm.

Of both Bones.—1. Backwards (most common). 2. Forwards. 3. Laterally.

1. When the bones are displaced backwards, which occurs from falls on the hand when the forearm is not perfectly extended, the symptoms are: 1. Shortening of the forearm anteriorly. 2. Projection of the olecranon covered by the triceps at the back, this being increased on flexion. 3. The olecranon is higher ($1\frac{1}{2}$ inches) than a line passing from one condyle to the other. 4. Distance between the tip of the olecranon and the internal condyle is much greater than on the sound side. (This is a distinguishing mark from fracture of the lower end of the humerus, where the distance is the same on both sides.) 5. The condyles can be felt on the front of the forearm. 6. Forearm is fixed in a semiflexed and semipronated position. 7. Great swelling: if the coronoid process be fractured, as often happens, crepitus can be detected. 8. Motions of the joint are suspended or limited, difficult, and painful, but an abnormal lateral motion can be produced. 9. The muscles in front of the joint are stretched like tense cords, and the triceps behind stands out in a marked degree.

Condition of the parts.—The coronoid process occupies the olecranon fossa, the head of the radius is behind the external condyle, the head of the humerus rests on the front of the radius and ulna. All four ligaments are ruptured. The triceps is relaxed, the biceps and brachialis anticus stretched or torn. Muscles arising from the condyles are relaxed. Median and ulna nerves exposed to pressure. Ulna and interosseous vessels compressed.

2. *Forwards* is usually accompanied by fracture of the olecranon.

Symptoms.—1. Lengthening. 2. Sigmoid notch occupies the front of the forearm. 3. Olecranon is higher than the condyles. 4. A depression can be felt at the back of the humerus in the normal situation of the olecranon, bounded on each side by the margins of the trochlea. 5. Forearm is sometimes extended but generally at right angles with the arm. 6. Skin and muscles in front of the joint are much stretched.

3. *Laterally.*—Cause: violence acting

upon the arm and forearm in opposite directions, as when the limb is wedged between the spokes and the side of a wagon. These dislocations are, as a rule, incomplete, the radius being placed opposite the internal condyle, and the ulna in contact with the external. They are readily recognised, and may be conjoined with the backward dislocation.

A rare form of dislocation of both bones consists in one being displaced behind the humerus and the other in front.

Dislocations of Single Bones.—The ulna may be displaced backwards. The symptoms are: 1. Projection of the olecranon at the back; 2. Olecranon is above the condyles; 3. Forearm is inclined to the ulna side and slightly flexed; 4. The radius is felt in its proper position on pronation and supination; 5. Flexion and extension restricted.

Cause.—Severe falls on the inner and upper part of the hand.

The radius may be dislocated: (a) forwards (most common); (b) Backwards; (c) Outwards; (d) Partially.

(a) *Forwards.*—Causes: Falls on the hand whilst the forearm is pronated. Direct violence to the outer side of the elbow. Struggles of a child when endeavouring to free itself from the grasp of a hand. The symptoms are: 1. Forearm is bent, semipronated, and cannot be brought beyond a right angle, or straightened; 2. The head of the bone can be felt on the front of the humerus when the arm is pronated; 3. The external condyle is very prominent. From the coronary, oblique, capsular, and interosseous ligaments being torn, it is difficult to maintain the bone in position.

(b) *Backwards* is rare, and may be accompanied by a fracture of the internal condyle.

Causes.—Falls on the hand while the forearm is extremely pronated. Direct violence to the front of the head of the radius. In wringing out clothes.

The symptoms are: 1. Hand is prone and cannot be supinated; 2. Elbow moderately bent and cannot be flexed or extended; 3. Depression at the proper site of the head of the radius; 4. The head can be felt at the back of the external condyle.

(c) *Outwards.*—This dislocation is very rare. The symptoms are: 1. The head of the bone is felt outside the external condyle quite subcutaneously; 2. The bone

is higher up than natural, and at a greater distance from the olecranon; 3. All movements are performed with difficulty.

(d) *Partial Traumatic* is met with in children generally under five, and is due to the orbicular ligament slipping upwards during a sudden jerk, pull, or twist of the forearm, when the limb is supinated or over pronated, as in dragging the child by the arm. The radius slips downwards and a little forwards.

Symptoms.—A snap is heard at the moment of the accident, the child cries and is in great pain. The forearm is semipronated and fully extended; it cannot be bent beyond a right angle. This is treated by flexing the elbow to a right angle, and fully pronating the forearm, when the displacement is rectified with a distinct click. This accident is by no means uncommon, many instances having occurred in my own practice; it is often reduced during the examination of the elbow. There is ordinarily no swelling or deformity at the seat of injury.

Treatment.—If the ulna be dislocated with or without the radius, traction downwards of the forearm and flexion over the knee will replace the bones. Gross recommends the surgeon's heel being used instead of the knee, the patient lying down and the surgeon carrying his leg across the chest while extension is made by pulling the hand and wrist. Another method consists in one assistant taking hold of the forearm, and another of the arm. The forearm is first hyperextended backwards until a little beyond a straight line with the arm, and then the elbow is bent whilst traction is still maintained; this can be helped by pressing the humerus forwards and the upper part of the forearm backwards, during the time the coronoid process is unlodged. Hamilton, in an old obstinate case of dislocation backwards, effected reduction after dividing the tendon of the triceps subcutaneously. After six or seven days, passive motion must be commenced. Should the radius alone be dislocated, the body is fixed by a towel passing under the armpit of the injured side, and extension made from the wrist, until the radius can be slipped into its place by the pressure of the fingers, assisted in forward displacement by pronation, in backward by supination. The after-treatment of these dislocations

consists in putting the limb in an angular splint for ten days, and then a sling for a fortnight.

Compound Dislocation demands, as a rule, resection or amputation. If the parts be not much lacerated, the wound should be enlarged and excision performed; but if the joint be extensively opened, the muscles torn, the artery or median nerve injured, and the bones much implicated, amputation is imperative.

Old Dislocations can rarely be reduced after a month, unless they be partial. Agnew writes, "It will be wiser to fracture the olecranon, and by regularly enforced motion to restore in this way the usefulness of the limb. The operation is easily executed by perforating the base of the process at two or three points with a fine drill, and afterwards breaking it away from the upper end of the shaft of the bone by forced flexion of the arm."

Dislocation of the Inferior Radio-Ulnar Articulation.—The lower extremity of the ulna is separated from the semilunar cavity of the radius, and may be displaced backwards or forwards. The posterior radio-ulnar, and sacciform ligaments, are ruptured, and the ulna separated from its triangular fibro-cartilage. Fracture of the radius is often present.

Backward Dislocation.—Cause: Extreme and violent pronation of the hand. The *symptoms* are: 1. A marked and moveable prominence at the back of the wrist; 2. The styloid process is not in a line with the fifth metacarpal bone; 3. The tendon of the extensor ulnaris stretches like a cord covered by the skin from the lower fifth of the ulna towards the metacarpal bone of the little finger; 4. Hand pronated, fixed, and inclined towards its inner margin; the fingers are flexed.

Treatment.—Flex the forearm to a right angle, then extend the hand and rotate it outwards, and press the bone into its place. Splint and compress, followed in four weeks by an elastic armllet.

Dislocation Forwards.—Cause: Violent supination of the hand.

Symptoms.—1. Unusual projection above the hand and somewhat across the face of the radius. 2. Loss of prominence of the lower end of the ulna at the back

of the wrist. 3. Hand supinated, fingers flexed.

Treatment.—Flex the forearm. Traction from the hand, counter-traction from the arm and forced pronation, then apply a well-padded straight splint.

Dislocations of the Wrist are rare, but may be either, 1. Backwards; 2. Forwards.

1. *Dislocation Backwards* occurs from forcible bending of the hand forwards, or from blows or falls on the back of the hand when it is flexed.

Symptoms.—1. Shortening. 2. Projection of the carpus at the back of the radius. 3. Prominence of the ulna and radius can be recognised on the palmar aspect.

2. *Dislocation Forwards* occurs from falls on the palm of the hand.

Symptoms.—1. Shortening. 2. Projection of the carpus on the palmar aspect. 3. Prominence of styloid process and the articular surfaces of the radius and ulna, forming a concave line on the dorsum.

Clement Lucas describes a form of dislocation, which he terms *dislocation by rotation backwards*. The hand is forced back so that the metacarpus forms a right angle with the back of the forearm. The carpus presses forward the tendons in front of the wrist, but otherwise there is no deformity. The carpus is over extended on the radius and ulna, but the ligaments are entire, and the dorsal aspect of the first row of carpal bones fills the articulating cavity of the lower end of the radius.

Treatment.—Traction on the hand with slight to and fro movements. Rest, with anterior and posterior splints reaching to the ends of the fingers for three weeks, and then passive motion.

Carpal Bones are rarely dislocated, but from falls when the hand is bent forwards, the os magnum may be displaced, and is recognised as a round solid tumour on the dorsum opposite the middle finger. The semilunar and cuneiform bones also may be dislocated, and the pisiform pulled upwards by the flexor carpi ulnaris.

Treatment.—Extend the part and press the bone forwards with the thumb. Apply two millboard splints.

Metacarpal Bones are rarely dislocated, though those of the thumb, index and middle fingers are occasionally displaced.

Treatment consists in extending the finger and pushing back the bone.

Metacarpo-Phalangeal Joint, especially that of the thumb, is liable to be dislocated backwards, from a fall or blow on the terminal phalanx when in a state of flexion.

Symptoms.—1. The joint becomes angularly concave behind. 2. The head of the metacarpal bone can be recognised on the palmar aspect. 3. The phalanx is in contact with the posterior surface of the metacarpal bone above its neck, and forms a characteristic swelling at the back of the joint. 4. The joint is semi-flexed. 5. The thumb is shortened and cannot generally be bent or extended.

Treatment is often very difficult, owing to the metacarpal bone being fixed between the two heads of the flexor brevis. Chloroform is of great use. Bend the displaced bone backwards till it is a right angle, then press the metacarpal bone towards the palm and extend the phalanx; on suddenly bending it forwards the displacement is often reduced. If this fail, flex extremely the metacarpal bone, and then rotate, and suddenly extend the displaced phalanx. If still unsuccessful, cut the constricting bands subcutaneously. Fix the thumb in the palm of the hand by a guttapercha splint, to be worn three weeks.

Phalanges are but seldom dislocated; if this occur it is easily recognised, and reduced by extension, forcible flexion, and pressure. Hamilton advises extension with forcible dorsal flexion in backward luxations, and forced palmar flexion in forward dislocations.

Hip Joint can be dislocated in four principal directions: 1. Upwards and a little backwards, iliac; 2. Backwards, sciatic, or dorsal below the tendon of the obturator internus (Bigelow); 3. Downwards and forwards, thyroid; 4. Upwards and forward, pubic. These dislocations of the hip are most common in male adults from twenty to forty-five. In twenty dislocations, twelve are iliac, five sciatic, two thyroid, and one pubic. The ilio-femoral or inverted Y ligament of Bigelow is an important structure in dislocations of the femur. It is remarkably strong and thick, and proceeds from the anterior inferior spine of the ilium, dividing into two portions, to be attached to the anterior trochanteric line, the outer

portion being inserted in the femur, near the root of the great trochanter, and the inner near the lesser trochanter.

1. *Iliac, or Dorsal of Bigelow.*—In this dislocation the head of the femur rests between the acetabulum and the sacro-sciatic notch upon the dorsal surface of the ilium. The capsular and round ligaments, gemelli, obturators, quadratus, and pyriform, are stretched or torn. The head of the bone always lies above the tendon of the obturator internus, and is directed backwards, with the trochanter forwards.

Causes.—Violence acting when the limb is abducted, or adducted and flexed, *e.g.* when a patient falls with a load on his back, or is struck on the back by a heavy weight. The head of the bone may primarily escape downwards, and secondarily be drawn on to the dorsum ilii, or directly be thrown on to the dorsum, where it rests on the gluteus minimus.

Symptoms.—1. Shortening ($1\frac{1}{2}$ to 3 inches). 2. Inversion (from the Y ligament being entire) and loss of extension, abduction, and rotation out. 3. Knee semiflexed in front of and above the sound knee, the axis of the injured thigh crossing the lower third of the sound thigh. 4. The foot of the displaced thigh rests on the opposite instep, and the heel is raised off the floor. 5. The distance between the crista ilii and trochanter is diminished; trochanter is more prominent than usual. 6. Hip appears widened from the approximation of muscular attachments. 7. Head of the bone can be felt in its new position rolling under the muscles when the limb is moved. 8. Fold of the buttock elevated and broader and flatter than natural.

The test lines mentioned in fracture of the neck of the femur, namely Nélaton's, Bryant's, and Morris's are useful.

Diagnosis from fracture by the presence of inversion, limitation of movement, resistance to extension, and absence of crepitus (*vide* table, p. 77).

Treatment.—1. By manipulation has now quite superseded extension. The patient being anaesthetised and placed on the floor on his back, the limb is flexed so that the knee is bent on the thigh, the thigh on the pelvis, the ankle being grasped with one hand and the knee with the other. The knee is made to touch the umbilicus, then abducted and

carried downwards, being rotated outwards at the same time. *Flex, circumduct outwards, rotate outwards.* It is often of service to steady the pelvis by placing a foot on it, and to forcibly raise the knee. Bigelow writes: "In reducing a dislocation of the hip by manipulation it is important to bear in mind that in every position the head of the bone faces nearly in the direction of the inner aspect of the condyle."

2. Extension is applied by means of pulleys connected to a hook six inches above the patient, and fixed to a belt attached above the knee. The counter-extension is obtained by a jack towel encircling the tuber ischii and the pubes, and fixed to a hook placed six inches below the patient, who lies on his sound side. The force is applied in the direction in which the limb lies, that is downwards, forwards, and inwards. When the bone has reached the acetabulum it is elevated by an assistant by means of another jack towel, into which he introduces his shoulders, and slipped into place by the surgeon, rotating the foot and knee outwards.

2. *Sciatic, or backwards, below the tendon of the obturator internus (Bigelow).* The capsule is torn below the tendon of the obturator internus, and the head of the femur slips below this tendon, which in some cases is wound tightly round the neck of the femur, between the head and its socket. The capsular and round ligaments are ruptured. The head of the thigh bone rests under the gluteus maximus on the pyriformis muscle, above the sacro-sciatic ligament and at the upper edge of the notch, or on the ischium, on a level with the ischial spine.

Symptoms are similar to those of the iliac variety, only less marked. 1. Shortening ($\frac{1}{2}$ to 1 inch). If the patient is placed on his back, and the thigh flexed at right angles to the trunk, the shortening is well marked. 2. Inversion and loss of power of extension, abduction, and rotation outwards. 3. Knee semiflexed, turned in, and directed across its fellow, but less so than in the iliac, the axis of the thigh being directed across the sound knee. 4. The great toe rests against the ball of the opposite one, the toes are not so inverted as in the preceding form, and when the patient is erect just touch the ground. 5. The trochanter is only slightly altered in position,

being a little above and behind its proper place; it is more prominent than usual. 6. Hip less deformed than in the iliac. 7. Head of the femur is felt with difficulty owing to the thick covering of gluteus maximus, and its sinking more or less into the notch. 8. The lumbar spine is arched when the limb lies in a line with the trunk, but when flexed on the pelvis the back rests flat on the bed; this is due to tension of the psoas and iliacus. This symptom, first noticed by Syme, is differential and characteristic. 9. Digital examination through the rectum or vagina will detect the head of the bone. 10. Pain and numbness from pressure on the sciatic nerve.

Treatment.—The same as for iliac, but more force must be used. As a last resource, the tendon of the obturator internus may be forcibly ruptured, the femur is adducted, being held flat on the bed, and the thigh extremely extended, then forcibly abducted.

3. *Thyroid.*—In this dislocation the head of the femur rests in front of the obturator foramen, on the obturator externus muscle. The ball is directed inwards and the trochanter major outwards. The Y ligament is entire, but the capsular and round ligaments lacerated, and the pectineus and adductor brevis torn.

Causes.—Violence applied whilst the limb is much abducted, as in falls with the legs widely separated, or a heavy body striking the hips when the limb is abducted and the trunk bent forwards.

Symptoms.—1. Lengthening (2 inches), but this appears more than it really is, from the obliquity of the pelvis. 2. Abduction and flexion of the thigh on the pelvis, from stretching of the gluteals, psoas, and iliacus. The limb is advanced in front of its fellow, and separated from it; the trunk is bent forward so that the patient cannot stand upright. Movements of adduction, extension, and rotation are impracticable. 3. Knee semi-flexed and much in advance of the sound one. 4. The foot is slightly everted, and at a distance from the other, the ball of the toe resting on the ground, and the heel being raised. 5. The trochanter is nearer to the middle line, but further from the anterior superior spinous process than natural; the usual prominence is completely absent, and sometimes replaced even

by a positive depression. 6. Hip flattened, the fold of the buttock lower than on the other side. 7. Head of the bone can be felt in its new position, at the upper and inner part of the thigh, beneath the adductors. 8. Muscles of the inner side of the limb form a tense cord parallel with the axis of the thigh.

Treatment.—1. Manipulation. The movements to be applied for this dislocation are flexion in the abducted position, then adduction and rotation inwards, the limb being brought down. *Flex. Circumduct inwards. Rotate inwards.* If this do not succeed, *Flex. Circumduct inwards. Rotate outwards with extension.*

2. Extension. The belt for the pulleys is fixed to the upper part of the dislocated thigh, whilst the counter-extending jack towel is carried round the pelvis and fixed to the wall, opposite the uninjured side, on a level with the body. Extension is made directly outwards, and the head brought into position by the surgeon passing his hand behind the sound leg, seizing the ankle and drawing the injured limb backwards, and towards the middle line.

4. *Pubic* (very rare).—Here the head of the femur is displaced forwards and upwards on to the pubic bone. The ball of the femur rests on the anterior part of the pubes and looks forwards, the trochanter being directed backwards. The head is on the horizontal ramus of the pubes, just above the thyroid foramen, but in rare cases it ascends so high as to be hooked into the pelvis. The capsular and round ligaments are ruptured. The bone is covered by the iliacus, psoas, and straight muscles, and is between the femoral vessels and the inferior anterior iliac spine.

Causes.—The body being suddenly bent backwards whilst the limb is fixed by the muscles, as in making a false step, or from violence applied whilst the limb is abducted to its back.

Symptoms.—1. Shortening (1 inch). 2. Thigh and leg flexed, abducted, and rotated outwards, knee cannot be brought close to its neighbour; adduction and rotation inwards are impossible. 3. The foot points outwards at right angles with, and separated from, its fellow. 4. Trochanter is from $\frac{1}{2}$ to $2\frac{1}{2}$ inches nearer the symphysis than upon the other

side, and approximated to the anterior iliac spine. It is less prominent than natural. 5. The hip is flattened, and the gluteal fold above its proper level. 6. Head of the bone can be felt on rotation under the integuments of the groin, external to the femoral vessels. 7. Pain and numbness from pressure on the anterior crural nerve. 8. Retention of urine is common.

Treatment.—1. By manipulation. Under chloroform the limb must be brought down, then *flex the thigh on the abdomen, circumduct inwards, rotate inwards*; in some cases rotation outwards is more successful. 2. Extension. Patient lies on his back, with the legs wide apart. The counter-extending band passes over the perineum and pubes of the injured limb, and is attached above the patient's head, in a line passing from the pelvis a little to his sound side; the pulleys are fixed on the lower part of the thigh, and extension is made downwards, outwards, and a little backwards, at the same time an assistant raises the head by a doubled towel. This dislocation may also be reduced by an extension of the thigh and counter-extension with the heel in the perineum, the limb being rotated inwards.

When reduction is completed, in all cases of hip dislocation, the limb is to be fixed to its fellow, or put in a long splint, or the starch bandage, for three weeks. The joint must not be freely used for a month. In old dislocations it is not prudent to attempt reduction after two months have elapsed.

Dislocations of the Patella are of four kinds: 1. Outwards; 2. Inwards; 3. Edgewise; 4. Upwards.

1. *Outwards* may be caused by muscular action in knock-kneed persons, or by indirect violence, as a twist of the thigh inwards while the leg is fixed, or by direct violence, as a blow on the outer margin of the patella. In both lateral dislocations the synovial capsule is ruptured and some fibres of the ligamentum patellæ and the capsule torn.

Symptoms.—1. Flattening of the knee and increase in breadth. 2. Protuberance on the outer condyle formed by the patella with its inner edge forwards. 3. Loss of power of flexion. 4. Notch between the condyles is visible under the skin. 5. Severe pain on attempting to move the joint. 6. The joint is fixed

and slightly bent. The dislocation may be incomplete.

2. *Inwards* (very rare).—The symptoms are similar to the external displacement, the bone being to the inner side of the internal condyle.

Treatment.—Place the patient on his back, flex the thigh on the abdomen, and raise the leg to relax the muscles—this can be done by placing the foot on the surgeon's shoulder—then press down the raised edge of the patella and the muscles will replace it. In difficult cases violent flexion may succeed. A back splint must be applied, and any synovitis treated, and afterwards a knee-cap worn.

3. *Edgewise, vertical, or axial.*—In this dislocation the patella rotates a quarter of a circle and becomes vertical in position, one edge being placed between the condyles and the other just under the skin. Sometimes the position of the patella is quite reversed, the anterior surface facing the condyles, and the posterior surface looking forwards.

Causes.—Violence applied to the edge of the patella, the limb being semiflexed, or excessive muscular action. Hamilton points out that an incomplete lateral may be converted into a vertical if the bone hitches on one margin, and the extensor muscle contracts suddenly, raising the other margin.

Symptoms.—1. One edge of the patella, usually the outer, forms a well-marked projection at the centre of the knee. 2. There is a depression on either side of this projection. 3. Limb is immovably extended or slightly flexed. 4. Extensor muscles are much stretched.

Treatment.—Give chloroform and forcibly flex the limb, slightly rotating the tibia. Reduction is often extremely difficult, owing to the edge of the bone being firmly interlocked in the intercondyloid space or in the rent in the capsule; in such cases, under strict aseptic precautions, an incision may be made into the joint and the bone replaced by a lever.

4. *Upwards* occurs when the ligamentum patellæ is ruptured and is treated as a fractured patella. After reduction all dislocations about the knee-joint must be treated by rest, straight splints, and evaporating lotions for three weeks, and afterwards a knee-cap worn.

Dislocations of the Knee are either: 1. Outwards; 2. Inwards; 3. Backwards; 4. Forwards; 5. By rotation outwards.

Besides these, subluxation of the semilunar cartilages sometimes takes place.

Causes may be from indirect violence, as a twist of the tibia on the femur when the foot is fixed, in falling from a height, etc.; or from direct violence, as a blow.

1. *Outwards and inwards* are, as a general rule, partial. The inner part of the tibia resting on the external condyle in the one case, and the outer on the internal condyle in the other.

Symptoms.—1. Deformity of the joint, which is much increased in width. 2. Knee flexed and rotated. 3. Hollow in the centre of the joint, from the patella being pushed to one side or the other. 4. Extensor muscles are relaxed. 5. Limb is not shortened.

Dislocation outwards may be confounded with oblique fracture of the outer tuberosities of the tibia and fracture of the fibula. Dislocation inwards is liable to be associated with injury to the internal saphenous vein. Much injury of the soft parts and ligaments usually attends these displacements.

Treatment.—Flex the thigh on the abdomen, straighten the leg, and rotate the limb.

2. *Backwards* may be complete or partial. The posterior and crucial ligaments of the joint are torn, and the heads of the gastrocnemius, popliteus, and quadriceps muscles, together with the popliteal vessels and nerves, are stretched.

Symptoms.—1. Shortening ($1\frac{1}{2}$ to 3 inches). 2. Knee extended, occasionally flexed. 3. The condyles of the femur project in front. 4. Projection in the ham of the head of the tibia. 5. Marked depression on each side of the patella, its ligament being drawn tightly under the articular surface of the condyles, and the fibrous covering of the joint derived from the vasti torn.

3. *Forwards* is more common than the backward, may be either complete or incomplete. It is occasioned by falls on the foot whilst the knee is bent, or direct violence on the lower and front part of the femur. The ligaments are extensively ruptured, and the popliteal vessels much compressed, or even lacerated. The popliteus muscle is always torn, and often the biceps and gastrocnemius.

Symptoms.—1. Projection of the lower end of the femur in the popliteal space, which by pressure on the nerves and vessels occasions great pain and loss of

pulsation at the ankle; in some cases gangrene results. 2. The head of the tibia moves upwards and forwards, resting on the front of the condyles. 3. Hollow above the upper border of the tibia, in which the patella usually is placed. 4. Shortening ($1\frac{1}{2}$ to 2 inches). 5. Relaxation of extensor muscles of knee. 6. Rotation of the leg.

Treatment of antero-posterior displacements consists in an assistant bending the thigh and keeping it in a semiflexed position by means of a jack towel placed round the ham, whilst extension is obtained by means of another towel round the ankle; a little manipulation will effect reduction.

4. *Dislocation by rotation outwards* is very rare. The inner surface of the leg is directed forwards and the fibula backwards. The tuberosities of the tibia are placed antero-posteriorly, and the patella projects on the outer side.

Treatment.—Extension and rotation of the leg inwards.

Subluxation of the Semilunar Cartilages is due to rupture of the coronary ligament. It is occasioned by sudden and forcible twists of the joint, as from tripping against a stone in walking and the like, or accidental internal or external rotation of the leg. The internal cartilage is most generally displaced. The displacement may be slight (most common) or severe, sudden or gradual. The anterior attachments are most frequently displaced, but the cartilage may also be moved outwards or inwards.

Symptoms.—1. Severe and sickening pain, from compression of the synovial membrane and stretching of the ligaments. 2. Knee semiflexed and incapable of being extended. 3. Swelling of the joint. 4. Loss of power, and inability to stand.

Treatment.—Give an anæsthetic, flex the limb extremely, then suddenly extend and rotate; a distinct snap is often heard as the cartilage returns to its place. Evaporating lotion, etc., to knee, and the application of a knee-cap are necessary. If the condition is frequently repeated and interferes with the comfort of the patient, Annandale advises the following operation. "An incision is made along the upper border of the tibia, on the side corresponding to the cartilage displaced, and it should extend from the border of the ligamentum patellæ out-

wards or inwards, according to the cartilage affected, for a distance of about three inches. The tissues having been divided, and the synovial membrane exposed, all vessels should be secured before the joint is opened. This having been done, the synovial membrane is excised in the same direction as the external wound, and the parts examined. A blunt hook is then inserted, and hooked round the anterior margin of the displaced cartilage, which is in this way brought into its proper position, and held there while two or three interrupted catgut sutures are passed through it and the periosteum and fascia over the edge of the tibia. In this way the cartilage is firmly secured in its proper place. The edges of the external wound are then brought together by sutures, and the dressing and a splint applied."

Head of the Fibula is occasionally dislocated forwards or backwards, as the result of direct violence. This accident is easily recognised by the projecting head of the bone.

Treatment.—Flex the knee and press the bone back into its proper position, then apply a starch bandage. Some permanent deformity usually remains.

Complications, which may follow dislocations of the knee, are compression and laceration of the popliteal vessels, giving rise to traumatic aneurism or gangrene. Acute traumatic arthritis. Compound dislocations as a rule demand excision or amputation.

Dislocations of the Ankle.—The astragalus being displaced from the tibia and fibula, but carrying with it in its normal relation the rest of the foot. These displacements are usually accompanied by fracture, and are the result of twists of the foot. As a rule, these luxations are partial, if complete they are often compound. The displacement may occur in five directions: 1. Outwards; 2. Inwards; 3. Backwards; 4. Forwards; 5. Upwards.

1. *Outwards* (most common) is accompanied by fracture of the internal malleolus, or rupture of the deltoid ligament, and fracture of the fibula about two inches from its lower end (Pott's fracture).

Symptoms.—1. The sole of the foot looks upwards and outwards. 2. Depression above the external malleolus at the seat of the fractured fibula. 3. Inner malleolus forms a projection under the

skin. 4. Inner side of the foot touches the ground, and the outer is raised off it. 5. Blood extravasation and effusion into the joint rapidly follow. When the dislocation is complete the trochlear surface of the astragalus occupies a position completely to the outer side of the tibia, and is drawn upwards. The fibula is also fractured (Dupuytren's fracture). The symptoms are: 1. The limb is shortened; 2. Foot rotated outwards; 3. External malleolus unduly prominent and above its normal position; 4. Internal malleolus projects unusually, and is below its proper situation; 5. Increased breadth of the ankle.

2. *Inwards* (rare) is accompanied by splintering of the tibia obliquely, the inner malleolus being torn off, and the peroneo-tarsal ligament ruptured. In some cases, fracture of the astragalus or fibula is conjoined.

Symptoms.—1. The sole of the foot looks upwards and inwards. 2. Projection of the external malleolus. 3. Outer side of the foot touches the ground, and the inner side is raised.

3. *Backwards* is associated with the fracture of the fibula, and rupture of the internal lateral ligament, whilst the tibia rests on the scaphoid and cuneiform bones.

Symptoms.—1. Shortening of the dorsum of the foot. 2. Projection and elevation of the heel. 3. Toes point downwards from contraction of the calf muscles. 4. Tendo Achillis very prominent. 5. Articular surface of the astragalus can be felt at the back part of the inner ankle. 6. Lower end of the tibia forms a marked prominence upon the instep.

4. *Forwards* is very rare. The tibia rests on the posterior part of the os calcis.

Symptoms.—1. Dorsum of the foot is lengthened. 2. The malleoli are nearer the heel than natural. 3. The astragalus forms a projection in front of the tibia. 4. Normal depressions at the side of the tendo Achillis are effaced.

5. *Upwards* (exceedingly uncommon), occurs from falls from a height on the sole of the foot. The tibia and fibula are forced apart and the astragalus pressed up between them.

The symptoms are: 1. Great widening of the ankle joint; 2. The malleoli are unduly prominent and near to the sole; 3. Absence of motion in the ankle joint.

Treatment for dislocations of the ankle is as follows. Give an anæsthetic, extend the foot (placed midway between flexion and extension at the ankle) on the leg, with the knee bent to a right angle with the thigh; a little traction will effect reduction. In difficult cases divide the tendo Achillis subcutaneously. Lateral splints should be afterwards applied.

Compound Dislocations are treated by amputation if the posterior tibial artery be injured, or the soft parts much contused and disorganised, and especially in the case of a patient above middle age. If the surrounding circumstances be favourable and the extent of injury small, the limb should be placed on a McIntyre's splint and the wound treated aseptically, or excision may be performed.

Subastragaloid Dislocations of the Foot, at the *Calcaneo- and Scapho-Astragaloid Joints*, whilst the astragalus maintains its relations to the tibia and fibula may be either: 1. Backwards; 2. Forwards; 3. Outwards; 4. Inwards. These dislocations occur from falls upon or twists of the foot, and are usually incomplete.

1. *Backwards* (very rare). *Symptoms*.—1. The foot is somewhat extended upon, and shortened in front of the leg. 2. The heel is lengthened. 3. The head of the astragalus forms a prominence on the dorsum, on the inner side of the foot, resting on the scaphoid.

2. *Forwards* (rare). *Symptoms*.—1. Foot is flexed on the leg. 2. Projection of the heel has disappeared. 3. Anterior part of the foot lengthened. 4. The extremities of the bones of the leg, with the astragalus, are directed to the posterior part of the calcaneum.

3. *Lateral Dislocations* are generally incomplete and frequently compound. In dislocation, *outwards*, the symptoms are: 1. Abduction and eversion of the foot, the outer border being raised, and the inner resting on the ground; 2. The outer malleolus is buried in the fossa, caused by eversion of the foot; 3. The inner malleolus and the head of the astragalus project greatly inwards; 4. The inner malleolus is nearer than usual the sole of the foot. In dislocation, *inwards*, the symptoms are: 1. Foot is inverted and the inner border raised, its outer resting on the ground; 2. Head of astragalus and outer malleolus project beyond the outer border of the foot; 3. A deep depression is present below the promi-

nence; 4. The inner border of the calcaneum projects on the inner side of the foot, concealing the inner malleolus; 5. The scaphoid is nearer the os calcis than natural; 6. Inner border of the foot is shortened and concave, outer lengthened and convex.

Treatment.—When partial, by relaxing the muscles of the calf the foot is easily replaced; when complete, reduction is very difficult, and subcutaneous section of tendo Achillis and tibials should be tried, and if this be not successful, splints should be applied and evaporating lotions, then if the skin slough, the astragalus can be partially or completely excised. If compound, reduction should be attempted and the wound closed, but should this not be possible, the astragalus should be at once excised. If amputation be necessary, Syme's or Pirogoff's operations are the best.

Dislocations of the Astragalus alone.—The astragalus being separated from all its articulating surfaces: these being in fact quadruple dislocations. There are four kinds: 1. Forwards; 2. Backwards; 3. Inwards; 4. Outwards.

1. *Forwards*.—The symptoms are similar to the preceding dislocation, but the astragalus is no longer in apposition with the tibia and fibula. The tibia rests on the os calcis, and the movements of the ankle joint are lost.

Symptoms.—Unusual prominence in front of the ankle, formed by the astragalus; the rounded head in front and the trochlear surface behind this, are easily made out.

Backwards.—The symptoms are: 1. The astragalus forms a hard swelling under the tendo Achillis; 2. Malleoli are nearer the sole of the foot; 3. Movements of the ankle lost; 4. Extreme flexion of the great toe; 5. No eversion, inversion, or alteration in the length of the tarsus.

Lateral Dislocations are never complete unless associated with fracture or compound, but forward or backward displacements may be conjoined with more or less lateral. In addition to displacement, the astragalus may be rotated on a vertical axis (version), or an antero-posterior one (torsion).

Treatment.—Tendo Achillis and tibial tendons must be divided subcutaneously. The patient being anæsthetised, extension and counter-extension are made, and the

bone pressed into its place. If reduction cannot be effected, the bone should be left, and if thought advisable, or if the skin slough, can be excised subsequently. Should the dislocation be compound, at once excise the astragalus without attempting reduction. The other tarsal bones are rarely displaced, but the

scaphoid, cuboid, and cuneiform bones have been met with dislocated.

Dislocation of the metatarsal and phalanges rarely occur without such an amount of injury to the foot as renders amputation necessary. These are treated as the same dislocations in the hand.

CHAPTER XV.

DISEASES OF JOINTS.

Synovitis — Suppurative Arthritis — Arthritis Deformans — Chronic Strumous Arthritis — Coxalgia — Sacro-iliac Disease — Ankylosis — Arthropathies — Moveable Bodies in Joints — Neuromimesis.

Synovitis or Inflammation of the synovial membrane may be acute, subacute, or chronic.

Acute Synovitis.—*Causes.* 1. The synovitis may be simple, arising from injury (as a wound, blow, wrench, sprain, or over-fatigue), or occurring from exposure. 2. Due to constitutional taint, syphilis, rheumatism or gout. 3. From absorption of morbid poisons, as in childbirth, pregnancy, gonorrhœa, menstrual disturbances, exanthemata, dysentery, etc. Most acute joint diseases commence as a synovitis.

Pathology.—The commencement is characterised by hyperæmia of the sub-synovial tissue, exudation of liquor sanguinis, emigration of leucocytes and increased proliferation and activity of the endothelial cells, which enlarge and become more granular. As a consequence of these changes the membrane is deprived of its satiny polish and becomes opaque, roughened, and vascular. The synovia is increased in quantity, assumes a turbid appearance, and contains shreds of fibrinous material and large quantities of leucocytes and oil globules, and there is often extravasation of blood into the joint cavity, especially in traumatic cases. If the disease be arrested these products are gradually absorbed; should this result not occur, pus is formed, and the other structures of the joint affected (*vide* Suppurative Arthritis). When due to absorption of morbid poisons the disease is nearly always multiple and affects the joints in the following order: knee, elbow, wrist, ankle, shoulder, sterno-clavicular, and hip. It is always well when a single

joint is affected in a male to ascertain the presence or absence of a urethral discharge.

Symptoms.—1. Pain worse at night, and on pressure or movement. 2. Heat which, if the joint be superficial, can be felt by the hand. 3. Swelling, considerable, and confined to the joint, which is much distended, causing bulging at the sides of the tendons surrounding the articulation and limited by the synovial reflexions. There may also be effusion of fluid into the peri-articular tissues, which will obscure the intra-articular distension. The peri-articular swelling is shapeless, and does not fluctuate, but pits on pressure. 4. Fluctuation. 5. Inflammatory fever. 6. Skin is usually unaffected, but may have a slight blush. 7. The joint is fixed and flexed from irritation of the articular nerves, causing reflexly contraction of the muscles round the joint, but the flexors being the stronger, the joint is bent.

Terminations.—When simple, resolution usually takes place. In other cases, especially those of rheumatic origin, the structures become thickened, fibrous bands forming within the joint, the motions of which are imperfect. If occasioned by a penetrating wound, or due to the absorption of morbid poisons, it is apt to pass on to suppuration (*vide* Suppurative Arthritis). Gross writes: "A joint that has once been inflamed from any cause whatever remains long weak and predisposed to disease, the most trivial circumstance tending to induce relapse and to reawaken the symptoms in all their primitive severity. A frequent repetition of the morbid

action must necessarily, by degrees, lead to disorganisation of the component structures of a joint, and to more or less extensive adhesions between the contiguous surfaces, eventually followed by complete loss of function."

Treatment.—If the lower limb be attacked, keep it raised, and apply cold assiduously by means of a Leiter's tube or ice bag, a back splint being fixed to the joint, and if this be flexed, weight extension. Cold must not be applied in rheumatic subjects. If these measures fail in arresting the disease, and local heat with pyrexia be present, leeches or cupping, as far as the patient's strength will admit, followed by hot fomentations, and belladonna and glycerine smeared over the joint.

General Treatment.—A low diet; salines with aconite and antimony, and calomel with opium. In the early stages elastic compression by means of a fine india-rubber bandage is useful. If the joint be much distended with fluid, this is to be drawn off by means of the aspirator, or, as recommended by Barwell, an elastic bandage is placed with some tightness round the joint, leaving clear the spot to be punctured. A tubular needle with an india-rubber tube, two or three feet in length and one-eighth of an inch in lumen attached to its neck, is used to puncture the joint. The tube is filled with a 3 per cent. solution of carbolic acid, and an assistant holds the end a foot or so above the joint, the needle is then thrust into the joint, and the tube at once lowered till it hangs perpendicularly downwards, except the last two or three inches, which should curve upwards. Fluid at once begins to flow. If flocculi block the needle, the synovial membrane should be divided subcutaneously with a tenotome. When of rheumatic origin, salicylic acid, colchicum and salines, with Dover's powder and warm fomentations and leeches. Nitrate of potash ʒj—ij in Oj—jss of water as a drink. Iodide of potassium is often serviceable. If syphilitic, calomel and opium with blisters to the joint. When occasioned by the absorption of morbid poisons, Barwell advises large doses of quinine, followed by sodæ sulpho-carbolatis ʒj with water ʒj. Stiffness remaining after acute attacks is best treated by rubbing and passive motion. Afterwards, active motion. If necessary the limb may be

straightened and moved whilst the patient is anæsthetised.

Subacute and Chronic Synovitis may be the result of the acute form, or the disease may be subacute from the first.

The symptoms are similar to those of acute synovitis, but much less marked. The weakness of the joint and the swelling are, however, considerable from effusion of serous fluid, loosening the ligaments and constituting in some cases hydrarthrosis, hydrops articuli, or dropsy of the joint. This is most common in young men, and in the knee joint; as a rare event it may occur in the shoulder, hip, and elbow. The synovial membrane is slightly swollen and œdematous, and in bad cases may be thickened from fibroid induration. In the knee the capsule filled with fluid bulges forward in the direction of the least resistance, that is above and at each side of the patella; in addition, this bone is felt to float, and by a slight tap can be made to strike the condyles of the femur whilst the limb is extended and elevated. With the knee flexed it is possible to move the knee-cap from side to side, which cannot be done in a healthy joint. The tibia is also capable of being moved laterally on the femur. Creaking can be sometimes felt on placing the hand on the joint and moving it, due to deposit in the articulation. The fluid is chiefly composed of serum, and is in many cases albuminous; it however remains clear, and does not contain many flakes or exudation cells. Barwell points out the important fact that occasionally in connexion with joints thus diseased, cysts are formed in the immediate neighbourhood; they are most commonly found in the popliteal space or the upper and inner part of the calf, and are due to protrusion of the synovial membrane through one of the apertures in the posterior ligament. As the cyst communicates with the knee-joint, if mistaken for an abscess the result would be very serious.

Terminations.—As a rule the prognosis is favourable, but relapses are common, and very rarely, where there is a strumous diathesis, the synovial membrane undergoes pulpy or gelatinous degeneration, ending in suppuration with its attendant sequelæ.

Treatment.—Rest, by means of splints, and the recumbent position as long as there are heat and pain in the joint.

Small blisters frequently repeated. Iodine ointment, oleate of mercury, and morphia. Painting joint with strong iodine liniment or strong nitrate of silver solution. Pressure with an elastic bandage. Subsequently soap or camphor liniments, with free shampooing and the continuous electric current, together with warm douches, and finally the joint should be firmly strapped.

General Treatment consists in improving the health in every way. If the urine be acid, bicarbonate of potassium and nitrate of potassium and ammonium, followed by vin. colchici and iodide of potassium, and sulphur baths. If the urine be alkaline, quinine, iron, salicylic acid, and good food. Cod-liver oil is often advantageous. In hydrarthrosis, iodine, ung. hydrarg. or oleate of mercury, with the preceding measures. Aspiration of the joint accompanied by pressure with an elastic bandage. Should this not succeed, a solution of tincture of iodine in water (3j—ij to 3j), or a one per cent. solution of carbolic acid, is to be injected into the joint and kept in from three to five minutes in order to produce a certain amount of inflammation; this is to be followed by pressure and cold douches. This failing, make a *free* incision into the joint with strict aseptic precautions, then drainage tubes are to be inserted, and the joint washed out every other day with some antiseptic through these. The general measures if there be a rheumatic tendency are iodide of potassium, James' powder, pulv. ipecac. eo., or guaiacum.

Suppurative Arthritis, or inflammation of the tissues of a joint, leading to the formation of pus, may be either acute or chronic, and commence either in the synovial membrane and capsule or in the bones, but spreading, however it originates, to the other structures of the articulation.

Causes.—Necrosis or caries of the articular ends of a bone; wounds, or injuries; septic synovitis, or synovitis due to infection with septic matter, as in pyæmia, the puerperal state, after the acute exanthemata, gonorrhœa, dysentery, etc.

Symptoms.—1. Pain, preceded or accompanied by rigors; the pain is of a very severe kind, the patient crying out at the slightest attempt to move the limb, usually worse at night, and referred to one spot. 2. Heat, associated with

redness, usually in patches. 3. Swelling, general, involving the whole articulation and surrounding soft parts, the place feeling soft, doughy, and œdematous on palpation, but not distinctly fluctuating at first, though as the disease progresses the joint becomes filled with pus, which may make its way outside the articulation and burrow among the intermuscular planes. 4. Position. The joint is semiflexed and the muscles contracted; there is a great tendency to displacement of the articular ends of the bones. 5. Superficial redness over the absorbents. 6. Starting pains when the patient is falling to sleep, from pressure on the inflamed bony surfaces when the muscles are relaxed. These always inform the surgeon that the bone is affected. 7. Inflammatory fever. In addition to these, further symptoms are produced as the disease progresses, namely those due to the occurrence of suppuration within the joint, grating on movement owing to the destruction of portions of the articular cartilages, allowing the bare bony surfaces to come in contact, whilst the ligaments are loosened or destroyed, and the bones often displaced. When suppuration is once established the fever assumes the hectic type.

Pathology.—In whatever way it originates, whether as the sequel of a synovitis, or the result of disease of the contiguous bone, the synovial membrane is red, swollen, and pulpy, its vessels dilated, with here and there thrombosis, and the membrane loses its polish. The cartilage follows the synovial membrane in the process of inflammation, and is soft, pulpy, opaque, and thickened, easily stripping off the bone. The cells multiply, the secondary capsules are dissolved, and the primary ones occupied by granulation tissue. Lymph is effused at the circumference of the joint, and the ligaments break down, softening, and becoming pulpy. The interior of the joint is full of pus containing flakes. The capsule and surrounding tissues are thickened, infiltrated with pus, or covered with lymph. The bone is vascular and soft. The changes in the synovial membrane and bone are simply those due to inflammation, and have been already considered (*vide* Synovitis and Ostitis), and it is only necessary now to briefly allude to the phenomena presented by the cartilage. As an initiatory step, the vessels adjacent

in the bone or synovial membrane undergo the usual vascular changes incidental to inflammation. The encapsuled cells of the cartilage increase in size, become more granular, and their nuclei more prominent. Multiplication of the cells by simple division then takes place, the new cells closely resembling pus corpuscles. The intercellular substance softens and disintegrates into granular matter. By the rupture of the capsules, the cells and granular matter escape from the surface of the cartilage, leaving pits or depressions (acute ulceration). If the bone is first affected, the same process occurs in the cartilage, only advancing in the opposite way, that is from the deeper layers to the surface. If the disease progresses, the cartilage disappears, and the bones are laid bare, the capsule being converted into granulation tissue, and the matter escaping from the joint by opening, directly externally, or spreading along the fascia round the joint. If the process be more chronic, the changes are not of so destructive a nature, as the new cells have a tendency to produce a fibrillated tissue, though some ulcers are still formed by retrogressive changes.

Repair is produced by the formation of a fibrous tissue, which connects the ends of the bones, and covers their surface with a cicatricial structure, but in other cases the exposed vascular bony surfaces grow directly together (ankylosis).

Treatment.—Absolute rest in a good position, with extension, obtained by means of a suitable splint (as Thomas' splint for the knee), and the weight and pulley. If necessary in adjusting the limb, give an anæsthetic. When pus has not yet formed, the joint may be painted with linimentum iodi., or linear cauterisation performed on each side of the joint with Paquelin's cautery. Directly suppuration is recognised, empty the joint by the aspirator, or by incision. The shoulder may be incised, parallel with and through the front portion of the deltoid, beginning close to the acromion and ending short of the neck of the humerus. Elbow, by a transverse incision at the junction of the radius and capitellum, but if necessary another incision is made along the outer border of the olecranon. The wrist, by incising along the course of the tendon of the extensor

minimi digiti. At the knee, two incisions in the long axis of the limb, in front of the external and internal lateral ligaments respectively. For the ankle, two incisions in front of the external and internal malleoli. Drainage tubes must be inserted, and the wounds treated on the strictest aseptic principles. The joint should be washed out frequently with some antiseptic by means of Es-march's irrigator.

General Measures.—If the pulse be full and bounding, vin. ipecac., tr. digitalis, and vin. antimon., are of service. To relieve pain, morphia with atropine, hypodermically, or belladonna and opium suppositories. If there be much rise of temperature, quinine gr. x to xx, or tr. of aconite and acetate of ammonia.

When the disease has assumed a chronic, or subacute form, the actual cautery, blisters, or some form of counter-irritation, and then enveloping the joint in a starch or plaster of Paris splint. In affection of the knee, Scott's dressing is serviceable. Hydrarg. perchlor. gr. $\frac{1}{12}$ in infusion of gentian, good food and tonics being the constitutional treatment. Later on, friction, cold water douches, and passive motion.

Prognosis in these cases is, as a rule, very unfavourable, amputation or excision eventually having to be resorted to, or death from pyæmia, exhaustion with lardaceous degeneration, tuberculosis, or hectic, will carry off the patient. Should the bones be healthy, however, ankylosis may be expected, and in very favourable cases motions of the joint may be retained. In young persons, when the joint has healed, the bone will be smaller than its fellow, and shorter, from cessation of the growth of the epiphyses and epiphysal cartilage. When ankylosis is likely to occur, the limb must be put up in as useful a position as possible, for instance, straight for the hip and knee, semiflexed for the elbow, etc.

Acute Arthritis of Infants is a variety of suppurative arthritis described by Mr. T. Smith. It depends on the inflammation of the epiphysal line running on into suppuration, the pus breaking down the tissues of the epiphysis, and bursting into the joint. The disease is met with in infants under a year, from absorption of septic matter, due to decomposition of the umbilical cord, etc.; the knee, hip, and shoulder are the most common seats.

Treatment consists in the evacuation of the pus as soon as diagnosed, and if possible before the joint is implicated, by the epiphyses being perforated, free drainage, and rest on splint. Stimulants and a supporting plan of treatment are necessary.

Arthritis Deformans, or Chronic Rheumatoid Arthritis, or Osteo-Arthritis, most commonly attacks the hip, but the shoulder, wrist, and lower jaw are also liable to this disease. It is met with in another form, affecting the joints of the fingers (polyarticular), occurring in females chiefly, at the change of life. This is probably the only disease of a joint which commences in the cartilage, and many authorities consider even this disease to begin in the bone or synovial membrane.

Pathology.—The cell cavities of the cartilage enlarge, and the cells slowly multiply, still however retaining their original type. The primary capsules fill with secondary capsules. The intercellular substance softens and breaks up into brush-like filaments, throwing the spaces filled with cells into one another, and their capsules being dissolved, the cells escape into the joint. In this way the cartilage loses its polish, presenting a rough surface and dull yellow colour, finally becoming worn away. The subjacent bone is laid bare, and the cancellous tissue being irritated, takes on a process of sclerosing osteitis and eburnation, a small quantity of new bone being produced, which is in its turn worn away. The bone adjoining the joint is the seat of the production of osteophytes; this is a very distinctive feature, the bony outgrowths (Haygarth's nodosities) having a dense and compact structure. These osteophytes take their origin from the margin of the articular cartilage *within*

the synovial membrane; the outgrowths from one bone are usually in contact with similar growths from its fellow. Similar formations occur about the insertion of tendons. The synovial membrane is vascular and swollen, forming fringes which give off new processes (arborescent budding); this new tissue becomes converted chiefly into connective tissue, but here and there patches of cartilage form, which may ossify. There is an increase in synovia, which is cloudy from minute fragments of triturated cartilage; in the polyarticular variety there is no synovia (dry arthritis). Loose masses of bone may be present in the subserous cellular tissue. The neighbouring ligaments and tendons become wholly or partially destroyed, leading to subluxation; the muscles are wasted. There is never supuration.

Causes.—Malnutrition, exhaustion of the nervous system, overfatigue, grief and anxiety, exposure to changes of temperature and damp, repeated pregnancy, prolonged lactation, menorrhagia, chronic dysentery, Bright's disease. There is always a rheumatic diathesis; often this being hereditary. The male sex is most liable, and it rarely occurs before middle life. It is most common in the poor.

Prognosis.—As regards life is good, but the disease is incurable and attended by much pain and inconvenience. There is a decided tendency to incomplete ankylosis; but the movements of flexion and extension are always preserved to a limited extent long after those of rotation and circumduction are lost.

Diagnosis, when associated with injury to the hip, and simulating dislocation, must be made out by the previous history. Mr. W. Adams gives the following differential table to distinguish this disease from Charcot's disease:—

RHEUMATOID ARTHRITIS.	CHARCOT'S DISEASE.
1. Changes chiefly hypertrophic.	Changes chiefly atrophic.
2. Commences with soft tissues.	Commences in bones.
3. Painful through its course.	Generally painless.
4. Pain confined to joint.	Pain shoots through limbs.
5. No febrile disturbance, gastric or ocular symptoms.	All these are present.
6. Reflex symptoms present.	Reflex symptoms absent.
7. Limited mobility.	Flail-like mobility.
8. Progress slow and chronic.	Progress rapid and acute.
9. Patients often reach old age.	Patients seldom reach old age.

To these may be added :—

10. Onset gradual.	Onset sudden.
11. First symptom slight swelling and crackling.	First symptom extensive swelling.
12. Condensation of bone.	Fragility of bone.
13. Dislocation rare.	Dislocation common.

Symptoms.—When the hip is affected, there are : 1. Pain, worse at night or in damp weather, increased later on by standing or walking, particularly after resting ; 2. On rotating the limb, crepitation is produced ; 3. Motions of the joint are impaired and limited, flexion being difficult, and stooping and sitting almost impossible ; 4. The trochanter is thickened and the bony outgrowths perceptible ; 5. Limb shortened (1 inch) ; 6. Pelvis directed obliquely ; 7. Position : the limb may be inverted or everted with the heel raised ; 8. Gluteal muscles are wasted on the affected side.

Treatment.—Rest by light splints and strapping. Good food, and improve the general health as much as possible. Warm woollen clothing. Local vapour bath. Warm and moist applications. Keep the bowels gently open with extract cascar. sagrad. liq. Acute pain may be relieved by leeching, or dry cupping, followed by belladonna, opium, camphor, or soap liniments.

General Measures.—Hot baths with carbonate of soda and potash. The medicines which are most useful are arsenic with iodide of potassium and sarsaparilla, guaiacum, sulphur and tartrate of potash, ammoniacum, iron, quinine, strychnia, ol. morrhue and salicylate of soda ; opium to relieve pain. In chronic stage, turpentine liniment, Domett flannel steeped in the liniment being bandaged with a flannel roller round the joint. Cotton wool or pine wool. Pine wood oil. Buxton, Harrogate, Tunbridge, Bath, Vichy, Carlsbad, Luchon, Aix, Teflitz, and Barèges are excellent places for the patient to obtain natural hot-water baths. The Woodhall Spa mineral water, which contains iodine, has done good taken internally. Peat baths and hot sand are of service. Massage and electricity. It is important that the patient should take as much exercise as possible to prevent ankylosis.

Chronic Strumous Arthritis, or Chronic Strumous Synovitis, or White Swelling

generally follows some slight injury, as a twist, fall, or blow, in strumous individuals of the female sex, and in children.

Symptoms.—1. The joint is enlarged and rounded, the bony projections being effaced, and the hollows of the joint filled up with a doughy, or semi-elastic swelling, equally resistant throughout. 2. The skin is of an unusual whiteness. 3. Little or no pain at first, except on motion, but starting pains of a night, when hyperæmia occurs under the cartilage, and commencing ulceration. Sayre writes : “In many cases disease of a joint may be recognised by the location of the pain ; in hip disease this is frequently referred to the knee. In a case of chronic disease of the knee joint you will always find the pain most acute, and most easily developed by pressure at the outer portion of the head of the tibia, just over the insertion of the coronary ligaments. It is quite common to be able to make pressure over the whole surface of the joint without causing pain, if you will avoid this particular point ; but the moment pressure is made over the internal or external coronary ligaments, more especially the external, pain will be produced. Pain can be developed at these points by a reasonable amount of pressure long after all other symptoms of joint disease have passed away, and treatment should be continued until this has disappeared.” 4. The joint is semiflexed, and in later stages subluxated and contracted. 5. The articulation is stiff and rigid, and the muscles wasted ; finally, the flexor muscles become converted almost into fibrous bands, and the extensors fatty.

The general health does not suffer much at first. The course of the disease is always chronic, as it progresses suppuration is apt to occur, and abscesses form in and around the joint, whilst hectic supervenes, and tuberculous deposits in internal organs.

Pathology.—The disease generally be-

gins with chronic synovitis. (First stage.) The changes in the synovial membrane increase, and it becomes thick, swollen, red, forming tufts or fringes composed of spongy granulations. These increase in size, gradually spreading over the cartilaginous surfaces, and becoming adherent to these by vascular roots. Around the vascular fringes the cartilage also is converted into a granulation tissue. (Second stage.) This is effected by an increased proliferation of the cartilage cells, which multiply rapidly, forming the round cells characteristic of granulation tissue, and by the disappearance of the hyaline matrix from mucoid softening. The bone subjacent to the cartilage becomes attacked by rarefying osteitis, leading to the formation of more granulation tissue, and the ligaments, having become swollen and pulpy, are also by the proliferation of the cellular elements converted into the same new tissue, which completely fills the joint. The muscles are wasted and shrunken. Abscesses are common outside the capsule. The granulation tissue has but slight tendency to cicatrization, it remains for an indefinite period embryonic tissue, and finally is prone to undergo fatty or purulent degeneration. In other cases the bone is first affected; hyperæmia of the nucleus of bone in the epiphysis, or at the line of junction between this and the shaft, giving rise to fungous osteitis, and this spreads secondarily to the cartilage. When the bone is laid bare, starting pains are present. The joint contains pus and broken down tissue. The suppurative process, however, may be more local, abscesses forming at different parts of the joint, pointing and healing up.

Sequelæ.—The granulation tissue may fibrillate, forming a cicatricial tissue (false ankylosis), or this may ossify (true ankylosis), or the granulation tissue may undergo fatty, or purulent degeneration, accompanied by the formation of abscesses, and often by dislocation of the bony surfaces.

Treatment.—In the early stages, a generous diet, sea air, tonics, as iron, quinine, maltine, mineral acids and bitters, cod-liver oil, iodide of iron and iodide of potassium, may be tried. The bowels

should be kept open by hydrarg. c. creta, or calomel and rhubarb.

Local Treatment.—1. Rest and complete fixation of the joint, with the limb in a good position; in the upper limb, starch or dextrine bandages are sufficient; in the lower, sand bags, with extension by the weight and pulley, or Thomas', or Dombrowski's splints. The patient should not be confined to the bed as soon as the most urgent symptoms of inflammation have past, but be allowed to get about with the affected joint *thoroughly fixed* in some apparatus. 2. Pressure, by bandages, strapping, sponge pads, etc. 3. Counter-irritation by blisters, or the actual cautery. 4. Hueter recommends the intrasynovial and intraosseous injection of carbolic acid solution ($2\frac{1}{2}$ to 5 per cent.) by a hypodermic syringe (m x xv for one injection). When the disease has arrived at a more chronic state, and the joint is stiff and thickened, repeated paintings with strong iodine liniment, passive motion, friction, and the cold water douche, will restore flexibility. Barwell recommends the injection into the peri-articular tissue of iodine solution (iodine $\frac{zss$, aqua \mathfrak{zviiss}) \mathfrak{zj} for one injection. Scott's dressing is here of use, and pressure with an elastic bandage. Should suppuration occur, the pus must be evacuated by free incisions, the granulation tissue removed by a Volkmann's spoon, drainage tubes inserted, through which the cavity of the joint should be washed out with some antiseptic, and absorbent cotton dressing applied.

Coxalgia, Morbus Coxæ, or Hip-joint Disease, like other joint affections, may be acute, subacute, or chronic. It occurs most frequently in childhood, but also in early adult life. The causes which may give rise to it are over exertion in walking, sprains, falls, or other traumatic injury, often of a slight character; cold. Barwell notices the association of hip-joint disease with phimosis in male children. It may commence as: 1. Synovitis; 2. Injury or rupture of the ligamentum teres or capsule; or 3. As an osteitis in the line of epiphysis, or an osteomyelitis.

Agnew gives the following table to distinguish synovial coxalgia from osteal coxalgia.

SYNOVIAL COXALGIA.	OSTEAL COXALGIA.
1. Lameness often before pain.	Pain often before lameness.
2. Pain at first slight.	Pain quite severe.
3. Marked tenderness when pressure is made over the external surface of the joint.	Little tenderness when such pressure is made.
4. Muscular rigidity moderate.	Muscular rigidity extreme.
5. Gentle movements of joint tolerated.	Movements not tolerated.
6. Pain not materially increased by crowding the joint surfaces together.	Pain greatly aggravated by such pressure.
7. Pain seldom paroxysmal.	Pain often paroxysmal.
8. Change in the position of the limb occurs early.	Change in the position of the limb occurs late.

Symptoms.—1. Pain at the commencement, often referred to the knee, owing to irritation of the articular branch of the obturator nerve; this pain is increased on movement, on striking the heel or trochanter, or on rotation inwards and abduction of the limb, and on standing or walking. It never passes along the nerve upwards, and is not increased on direct pressure on the knee.

2. Spasm of the muscles and rigidity of the joint.—This is owing to reflex irritation and affects the psoas, iliacus and adductors, but may be confined to one group of muscles. When the joint is extended some arching of the spine (lordosis) will be apparent, but on laying the patient flat on his back on the table or floor, and raising the limb, this disappears, on bringing the limb down flat, pelvis again becomes tilted and the curve re-established. This curving of the spine in the early stages will be overlooked if the examination is not made on a flat surface. Complete flexion is impossible, the sound limb can be bent until it touches the chest, but the diseased limb cannot touch the chest without the pelvis being raised off the table. Adduction, abduction and rotation are limited.

3. Position.—In the first stage, when the patient is erect the limb is slightly flexed, abducted and everted, the patient treading on his toes to break the shock, and drawing up the heel. This is due to either reflex contraction of the flexors and external rotators, or distension of the capsule by fluid. In the second stage, the thigh is still more flexed, but adducted and rotated inwards, the bone being bent and the pelvis flexed forwards. The trochanter often projects abnormally.

4. Atrophy of the limb and the mus-

cles about the hip and thigh is an early symptom. The gluteal muscles are flattened and lower than on the sound side.

5. Length of the limb.—In the first stage the leg is slightly elongated from abduction of the thigh, relaxation of the ligaments, and excess of synovial fluid. It appears longer than it really is from the pelvis being tilted downwards. In the second stage there is decided shortening, from half an inch to $1\frac{1}{2}$ inches, owing to atrophy of the head and neck of the femur and acetabulum, or dislocation on to the dorsum ilii, or separation of the epiphysial head with diminished growth of the femur. The pelvis is tilted upwards, and so gives an appearance of increased shortening.

6. Swelling and increased heat.—Generally observed in the groin, just below Poupart's ligament, and behind the trochanter.

7. Obliteration of the gluteal fold, from the flexed position of the limb and atrophy.

8. Arrest of development may take place in children in the surrounding parts, the pelvis often remaining small on the diseased side; this is especially the case when the disease occurs in, or continues into the period of menstruation.

9. Suppuration generally ensues, ushered in by fever, starting pains, erepitis and fulness in front or behind the joint. Abscesses form and point in the gluteal region, under the pectineus, above or under Poupart's ligament, outer part of the thigh, by the side of the rectum, and very rarely into the rectum, and at the back of the thigh. In cases where the acetabulum is involved, suppuration within the pelvis may often be detected by the finger passed into the rectum.

10. Sinuses are met with in the before-mentioned situations, as the result of the abscesses, and are important as giving a guide to the portion of the bone affected.

(a) When the sinus opens on the outer aspect of the thigh, at the insertion of the tensor vaginae femoris, or on the inner side of the thigh, the disease may be confined to the femur.

(b) When in the gluteal region the disease may be confined to the femur, but frequently the dorsum ilii or acetabulum is involved.

(c) If in pubic region the pelvis is the place affected.

11. Dislocation when present is nearly always iliac. It is produced by (a) softening and destruction of the ligaments; (b) caries and absorption of the head of the bone; (c) separation of the epiphysial head; (d) when the acetabulum is carious the head of the femur may slip through the bottom of its socket into the pelvic cavity.

12. Ankylosis is the most favourable termination either osseous, fibrous, or by the formation of a false joint on the dorsum ilii.

Complications. — Amyloid degenerations and tubercular meningitis.

TABLE OF SYMPTOMS.

1st Stage.	2nd Stage.
1. Limb lengthened.	Limb shortened.
2. Abduction and eversion.	Adduction and inversion.
3. Flexed at both joints.	Flexed at hip joint only, possibly at knee also.
4. Pelvis lower on diseased side.	Pelvis raised.
5. Pelvis projected forwards.	Pelvis projected backwards.
6. Nates low and flat.	Nates high and round.
7. Angle of inclination acute.	Angle of inclination almost right.
8. Foot touches the ground with the sole.	Foot touches with the toes only.
9. Linea inter nates inclined to the affected side.	Linea inter nates deviates from the affected side.
10. Pain severe.	Pain diminished.
11. Abscesses rare.	Abscesses common.

Diagnosis.—From *Infantile Paralysis*, affecting only the muscles about the hip, coxalgia may be distinguished by the fact that in infantile paralysis: 1. Onset is sudden; 2. Passive motion, free and painless; 3. Active motion limited, but painless.

In Congenital Dislocation of the Hip.—1. No pain in passive motion. 2. Child moves readily, although with a rolling gait. 3. Shortening is present from the first, but the length of the limb can be restored by traction.

In Sacro-Iliac Disease.—1. If the crests of the ilia are held firmly, there is no pain on moving the hip. 2. By compressing the wings of the ilia, pain is caused at the seat of disease, also on pressing together the sides of the pelvis. 3. Position in sacro-iliac disease is peculiar, as the patient bends the body over to the opposite side, and there is no abduction or eversion of the limb. 4. Pain is caused by pressure over the sacro-iliac joint, but no pain is occasioned by pressing the head of the femur against the acetabulum.

In Knee-Joint Disease.—1. The limb

is flexed at the knee and hip, but the position can be varied at will. 2. Patient can bring the limb behind the sound one, touch the ground with the heel, and can evert, invert, adduct, or abduct the hip readily.

In Periostitis of the Trochanter.—1. The symptoms commence suddenly, the femur is enlarged and painful on pressure. 2. The joint is free and painless.

In Potts' Disease and Psoas Abscess.—1. Pain in spine, and tenderness on pressure. 2. Limb may be extended under chloroform. 3. Fluctuating swellings above and below Poupart's ligament. 4. Pelvis square and nates even. 5. Hip articulation is quite free in its movements when the thigh is flexed. 6. Patient cannot walk except by supporting the spine by resting the hands on the knees.

Caries of the Ilium is distinguished by the absence of symptoms of hip-joint disease, and examination with a probe.

In Inflammation of the Bursa beneath the Psoas.—1. Presence of well-defined resisting elastic tumour, more or less deeply seated over the front of the hip joint. 2. Passive motion of the joint is

free and painless when the thigh is flexed. 3. No pain on pressing the joint surfaces together.

In Inguinal Abscess, depending on inflammation of the glands of the groin.—

1. Extension and abduction increase pain.
2. Pressure on the shaft of the femur or trochanter does not usually occasion pain.

In Perityphlitis.—1. Swelling is limited to the iliac fossa. 2. No pain on crowding the joint surfaces together. 3. When thigh is flexed, passive motion is free and easy.

Treatment is similar to that for other diseased joints, leeches and ice being useful in the initiatory stage. The three chief modes of treatment are: 1. Rest in the horizontal position; 2. Rest with extension; 3. Extension conjoined with motion.

1. Rest in the horizontal position is exceedingly advantageous in combination with other plans of treatment. The patient may recline in the supine position on a hard mattress to prevent the pelvis sinking, or better in prone position on a prone couch.

2. Rest with extension. This is most generally serviceable, and is effected by the weight and pulley, the foot of the bed being raised ten or twelve inches by means of bricks or blocks. Dombrowski's splint, or Thomas's splint, is useful. Double long splint, or the splint with stirrup or weight extension. To obviate adduction, a long splint is attached to the sound limb, and a cord fastened to the lower end of this runs up along the outside of the splint to the head of the bed, and then passes over a pulley, supporting the same weight as is carried by the diseased leg: 3 to 4 lbs. weight in children under ten, and 9 to 10 lbs. weight in adult is sufficient. Weight extension must be continued from three to six months after all pain and rigidity have disappeared.

Noble Smith recommends Mr. Chance's plan of treatment, which he thus describes. The chief objects of it are: 1. To subdue inflammation; 2. To restore free movement.

The most important indication is *rest* to the inflamed joint, and immediately this is afforded, pain generally ceases. The best means of obtaining rest are: 1. The prone couch; 2. The mechanical instrument. Upon the prone couch the patient reclines in a position of perfect

rest to the diseased joint. He can move his arms and body, can play, read, work, and eat easily, and without disturbing the joint; whereas, in the supine position on an ordinary bed, these occupations are accomplished with difficulty and with disturbance of the diseased parts. The apparatus is constructed as follows:—A pelvic belt A is adapted below the iliac crests; an upright bar B passes from this belt to the height of the shoulders, and terminates in a pad. From this pad proceeds straps C, forming armlets, or shoulder straps. From the pelvic belt proceeds a stem D, which is fixed by a leather casing to the thigh, and the stem is movable by means of rack joints, E, in the directions both of flexion and extensions, as well as abduction and adduction. This splint fixes the spine, and prevents movements of the pelvis. In applying it, the inclination of the joints is adapted to the position in which the limb is held by the patient. The joint is moved gradually, day by day, into better position by the surgeon, the instrument being altered to fit the new position. The instrument and couch should be both employed, and under no circumstances must the patient walk about. When he has improved so as to be able to take exercise, the side bar of the instrument is extended to the ground and attached to the sole of the boot, having a cog-wheel joint at the knee, and a front stop joint at the ankle.

3. Extension combined with motion. This is carried out by Thomas's splint, an iron patten being put on the shoe of the sound limb, and the patient getting about with the help of crutches. Sayre's apparatus is thus described by him: "It consists of a pelvic band passing partly round the body under the crest of the ilium, well padded on its inner surface, to which usually two perineal bands are fastened for counter-extension; its outer surface holds a ball and socket joint, from which runs a steel rod or bar down the outer side of the thigh, to within about two inches of the lower end of the femur. This outer bar is divided into two sections, one running within the other, and gauged or controlled by a ratchet and key, which can make it longer or shorter. At the lower extremity of this outer bar is a projecting branch going over to the inner surface of the thigh to receive the attach-

ments of the plaster. Both of the lower extremities terminate in a cylindrical roller, over which the two tags of the plasters are attached to the two buckles placed at the lower ends of the instrument." To apply the extension, the foot and ankle are bandaged, and two strips of plaster, two to three inches wide, with a piece of strong webbing three or four inches long attached to the lower end of each, applied to either side of the leg from the malleoli to halfway up thigh, and fixed with a bandage. Next take a piece of thin board about three inches long and two inches wide, and arrange across it a piece of tape or webbing, so that it shall project three or four inches on either side. To the ends of these tabs fasten buckles or buttons, that they may be attached to the ends of the tabs on either side of the limb. To the middle of this footboard is attached a stout cord, which passes over a pulley at the end of the bed, and has suitable weight for extension (bag of shot or sand). This weight extension is for use at night. To apply the short splint, two fan-shaped pieces of plaster as broad as half the thigh are taken, and slit into strips of an inch for purposes of adjustment, of sufficient length to reach from the knee to the groin. To the narrow lower end of the strip a piece of stout tape or webbing is stitched, three or four inches in length, and as wide as the cylinder at the lower extremity of the instrument. The instrument is fitted to the limb with its thigh piece about three inches above the condyles, and the points marked with the finger and thumb where it touches the limb. At these two points apply the fan-shaped pieces of plaster, and fix them by a roller from the knee to the perineum, turning downwards the loose ends of the plaster, and bandaging again downwards from the perineum. The shaft of the splint is shortened, and the splint fixed in position, with the pelvic cross bar just under the crest of the ilium. The tabs are buckled to the thigh piece, and the straps passing behind the thigh and the perineal bands also buckled. Extension sufficient to prevent pain when the heel or knee is struck is now made by the key. The patient, unless a small child, must use crutches. It is important to: 1. Always shorten the shaft before applying or removing the instrument; 2. See that the

jaws are tightly buckled, so that they will not press on the condyles; 3. Do not touch the tape between the roller and the buckle; 4. Do not buckle the perineal bands too tightly. In the case of small children Sayre uses a splint which he terms the "wire breeches," consisting of a wire-wove cradle for the body, with two back splints of the same material, and continuous with the body part, for the legs. This is well padded, and the child resting in it can be easily carried about. When the disease is sub-acute, extension should be made always in the *line of the deformity*. Fluid is removed by aspiration, blisters, and iodine, with the leg fixed on one of the foregoing splints. Cod-liver oil and iron internally, with a nutritious diet. Treatment must be continued from six months to two years. If abscesses form, open early under aseptic precautions. Should the pus not keep pure whilst crepitation is felt in flexing the thigh, and the child is exhausted and wasting from the long-continued discharge, open the sinuses freely, scrape abscess cavity with a Volkmann's spoon, and use antiseptic irrigation. In some cases excision or amputation is called for.

Sacro-Iliac Disease.—Causes: injury, struma, pyæmia (very rarely). Mostly occurs in young adults. This joint may be affected secondarily to caries of the ilium or sacrum.

Symptoms.—Weakness in the lower part of the back, fatigue and feeling of unsteadiness in walking. Pain over the joint, or reflected along the sciatic nerve or its branches (simulating sciatica), or along the anterior crural or obturator nerves (pain in hip or knee). The pain is increased on movement, or when weight of the body rests on the pelvis, as in standing or sitting. If the crests of the ilia be compressed, pain is increased. Swelling just inside the posterior iliac spines. The patient bends the body over to the opposite side. Limb may be slightly flexed from irritation of the psoas. Apparent lengthening is common, rarely apparent shortening. As disease progresses the gluteal muscles waste, and suppuration occurs. Abscesses form behind and directly over the joint, but may follow the small rotator muscles from the pelvis to the region of the trochanter, or pass along the iliacus muscle, and point above or under

Poupart's ligament, and occasionally form under the glutei, and burst into the rectum or the ischio-rectal fossa.

Treatment.—Rest in bed. A firm belt round the pelvis. Actual cautery over the joint in the early stages. When patient can get about, plaster splint round leg, hip, and pelvis, and crutches, with a high shoe on the sound limb. If abscesses form, free incision and drainage under aseptic precautions, with removal of diseased bone as far as possible by the gouge, osteotrite, etc., the opening being enlarged with the trephine, if necessary. Scraping sinus with a Volkmann's spoon is of service.

Ankylosis, or Stiff Joint, may be: 1. Incomplete or fibrous; 2. Complete, bony, or synostosis, which may be inter-articular, extra-articular, or both.

Causes.—1. In old age, osseous growths or loss of elasticity in the ligaments, the joints most affected being the costo-vertebral, intervertebral, and sometimes the carpal, tarsal, and sterno-clavicular, and others. 2. Structural changes, the result of inflammation, either general, traumatic, or specific, but especially scrofulous, rheumatic, gouty and syphilitic. 3. Pressure has been supposed to give rise to ankylosis, in lateral curvature, for instance. 4. Long continued repose of a joint in one position (Noble Smith.)

1. Incomplete results from either: (a) Thickening and cicatricial contraction of the capsule and accessory ligaments; (b) Formation of fibrous bands from inflammatory new formation inside the joint; (c) Junction of two osseous surfaces by cicatricial adhesion between the articular surfaces, formed of connective tissue replacing the cartilage; (d) Osseous deposits formed in the joint; (e) Muscular contracture; (f) Adherent cicatrices.

2. Complete occurs either from direct union of the two raw bony surfaces, or these being partly joined by fibrous bands, and partly by osseous. In the incomplete form there is slight motion, but in the complete the bones are firmly united. In the incomplete form, if it be doubtful whether union is not complete, pain, tenderness and inflammation, following the necessary manipulations for diagnosis, will show that some motion is present in the part though not perceptible at the time.

Barwell writes: "A short sharp attack of sero-synovitis may leave

behind considerable restricted mobility, nearly always the result of perisynovial impediment. If the attack of acute synovitis have been accompanied by marked pyrexia, considerable suffering and starting pains, a firmer and wider perisynovial impediment, and ligamentous shortening, even (according to the severity of the disease) some false ankylosis may be looked for, but an ankylosis not extending over the whole joint area. If the attack have been still more violent, and convalescence slow, more especially if abscesses have formed, true ankylosis may be expected, but sometimes false is found. After the absorptive diseases, various states are left. Exanthematous and urethral synovitis rarely give rise to worse effects than perisynovial bands, usually slight ones. Uterine and catamenial synovitis produce, if the attack be quickly overcome, but little restriction, but if it be persistent true ankylosis is not uncommon. Pyæmic synovitis does not often end in ankylosis: usually indeed, when the patient recovers, the joint regains its functions with great facility, but sometimes very obstinate perisynovial bands are formed. Long chronic maladies are generally followed by true or false ankylosis. Strumous synovitis generally leaves firm fibro-cartilaginous ankylosis, but if the neighbourhood of the joint be marked by the depressed scars of old sinuses, from which bone detritus has come, true ankylosis is to be expected. Acute monarticular rheumatic synovitis, of some duration and severity, is very apt to leave true ankylosis. Joint stiffness after disease, commencing in the bones, except arthritis deformans, is usually due to true ankylosis. If the bones be not fixed, excessive mobility, especially in abnormal directions, is very usually present. True ankylosis is more rare in enarthrosis than in ginglymus, it is scarcely ever present in the tempero-maxillary articulation. With every form of joint stiffness, muscular contraction is usually conjoined; it is most marked in the cases that have been longest kept at rest, and in which the more severe starting pains have occurred."

Treatment.—Care must be taken in all cases likely to terminate in ankylosis, to maintain the limb in the most advantageous position, *i.e.*, straight for the

hip or knee, semiflexed and semipronated for the elbow. When a limb has been ankylosed in a good position, but remains stiff, the union being fibrous, passive motion, friction, warm salt-water douches are useful, and any adhesions may be broken down under an anæsthetic. When in a faulty position, anæsthetise the patient and forcibly bring the limb in its proper place. This is best done by first forcibly flexing the joint, then extending it, and repeating these movements until the limb is rectified. The hands only should be used, and no apparatus. Tenotomy is a great aid; the extensors rarely require division; the flexors, if more than a slight rectification is required, nearly always do so. Complete rupture of resisting bands is less often followed by inflammation than partial, so a succession of jerks should be used and not continuous force. The following conditions are imperative: 1. The general health of the patient must be good; 2. Several months should have elapsed after active inflammation has ceased before such treatment should be adopted in any case; 3. When the ease has been associated with a scrofulous diathesis, it is safer not to employ this plan of treatment until several years have elapsed, nor until the patient has been perfectly restored to health; 4. In early life great care is necessary to prevent injury or separation of the epiphysis from the shaft. (Noble Smith.) Ice will restrain any subsequent inflammation with rest on a splint, and weight extension; finally use passive motion and friction. Slow extension by the weight and pulley is serviceable in cases where forced extension is not advisable. If the ankylosis is complete and in an advantageous position, let it alone, except in the case of the elbow, which should be sawn through to produce a movable joint. If the joint be unfavourably ankylosed, under aseptic precautions through a subcutaneous wound, saw, chisel, drill or break through the bone, or take out a wedge-shaped piece and rectify the position. The best plan is to chisel transversely through the bone above the joint, and if necessary below also.

Arthropathies from changes in the nerves or nervous centres due to injury or disease. Joints supplied by nerves which are either in their course or centres

injured or diseased, are apt to assume a synovitis with effusion, or an inflammatory action, followed by contraction and ankylosis. In persons suffering from locomotor ataxy, Charcot has described characteristic joint affection. This disease generally begins after the lightning pains have lasted some time, and before inco-ordination commences.

Morbid Anatomy.—The bursæ round the joint are large and relaxed from distension with fluid. Ligaments and capsule distended and relaxed. The synovial membrane is thickened and greyish, without fringes; the synovia citron-coloured, thick or purulent. Movable bodies may be present in the joint. The cartilages are absorbed wholly or partially, and the bone worn away. In some parts the osseous substance is rough, in others polished. Osteophytes are rarely present. One or more joints may be affected in the following order: knee, shoulder, hip, elbow, and wrist.

Symptoms.—The attack is always sudden, the patient awaking with the limb greatly swollen, especially at the joint, and pitting on pressure. There are no pain, tenderness, redness, and pyrexia. Rapidly absorption, even of the whole head and neck of a long bone occurs, giving rise to distortion and dislocation. Spontaneous fracture results from the slightest force. These dislocations and fractures are quite painless. For the diagnosis from arthritis deformans, *vide* that disease.

Treatment.—Rest, and light splints to the limb.

Movable Bodies in Joints are not uncommon. They are detached portions of hypertrophied synovial fringes, of a fibroid character, and more rarely cartilaginous, but occasionally osseous, calcareous, or lipomatous. Barwell gives the following modes of formation: 1. By hypertrophy and metamorphosis, from one or more of the synovial fringes; 2. By histogenetic transformation of some spot or spots of parasynovial tissue; 3. By growth from the periosteum, at the edge of the articular cartilage; 4. By organisation of a clot of fibrin, or of blood effused within the joint; 5. By direct growth from the articular cartilage; 6. By detachment through injury of a piece of the normal joint. Most of these cases are met with in rheumatic individuals.

These bodies vary in size from a pea to a chestnut. In shape they may be oval, circular, chestnut-shaped, mulberry, or pyriform. They are smooth, glistening, of a golden or greyish white colour. The body may be completely isolated or moored by a slender filament to the synovial membrane. The number ranges from one to great numbers. The most common seat is the knee, and occasionally in the elbow, wrist, and temporo-maxillary articulation.

Symptoms.—1. Intolerant pain, peculiarly dull and sickening, caused by the body being nipped between the articular surfaces, and occurring when the knee is bent in walking. It is the severe stretching of the ligaments which occasions the pain. 2. The limb is rigid, and the muscles fixed spasmodically; this is followed by rapid effusion of synovia, such attacks presenting themselves at intervals. 3. In many cases the body can be detected beneath the capsule of the joint by the finger, gliding away as soon as it is touched, and difficult to fix. The most common situation where the body can be found is on either condyle of the femur, more especially the outer, just above the junction of the bones.

Treatment.—1. Limit the movements of the joint by a knee-cap and bandage, but of course this is only palliative. 2. Radical cure. Under aseptic precautions, fix the body, draw the skin aside, and cut down on it, and extract it; the wound is closed with stitches. If the body cannot be fixed, the finger must be passed into the joint, or the body seized with vulsellum forceps. Before the introduction of the aseptic method of treating wounds the great danger of this operation was acute synovitis. To obviate this, the body was first fixed by a

grooved needle inserted into it through the skin, and then removed subcutaneously by a tenotome passed obliquely through the skin two inches below the joint, and dividing the capsule and cellular tissue; then the body was slipped down two inches along the cellular tissue and kept in position by a pad and plaster, being removed subsequently by another incision. An ice bag was applied to the joint. Square divides the capsule subcutaneously, the loose body being fixed, and presses the latter into, but not through the synovial aperture, where it is retained by a compress and strips of plaster. The body adheres and is absorbed. Syme recommended subcutaneous division of the synovial membrane, and applying a blister over the part where the loose body is retained.

Neuromimesis, or Hysterical Affection of a Joint, is not uncommon, particularly in females. The affection, generally simulated, is one of the acute inflammatory diseases. The symptoms are those of the real complaint, but the pain is severe, widespread, and out of proportion to the other symptoms. The patient cries out when the skin is touched, however lightly, over the joint, but if the limb is grasped at a distance from the joint, and the bony surfaces pressed firmly together, she does not complain, especially if her attention is taken off by engaging her in conversation. If chloroform be given, the joint is freely movable, and does not become rigid until the patient is fairly conscious; in real disease the joint returns to rigidity at the very first dawn of consciousness when the influence of the anæsthetic is commencing to disappear. The temperature of the joint is the same as its fellow provided the external conditions are similar. Redness, swelling, and fever are absent.

PSEUDARTHRITIS.	ARTHRITIS.
1. Generally seen in females.	1. Occurs in both sexes with equal frequency.
2. Swelling slight or absent.	2. Marked swelling.
3. No redness.	3. Often redness.
4. More pain complained of from a light touch than when joint is firmly grasped.	4. Pressure more painful when firm.
5. Pain superficial.	5. Pain deep-seated.
6. Symptoms exaggerated.	6. Symptoms not exaggerated.
7. Limb does not waste much.	7. Limb wastes.
8. Attack sudden.	8. Attack gradual usually.
9. Flexion may or may not be present.	9. Flexion always present.
10. Twitching of muscles, but not attended with much pain, and ceasing as patient falls asleep.	10. Starting pains when patient is falling to sleep.
11. No fever or constitutional disturbance.	11. Fever and constitutional disturbance.

Treatment is directed to the general condition of hysteria. Massage, isolation, and faradisation with wire brush are useful. If limb is flexed and rigid, under an anæsthetic, straighten it and

keep it so by applying a splint. A blister to a distant part is sometimes of service in directing the patient's attention away from the place.

CHAPTER XVI.

EXCISION OF JOINTS.

Cases suitable for Excision.—1. For disease of a joint, when an articulation is so extensively involved that the patient is liable to succumb to the copious discharge and pain, unless the offending part be removed.

2. To restore the mobility and utility of a limb or joint, as in osseous ankylosis of the elbow joint, or in old unreduced

dislocations in which the head of the bone presses on the nerves, causing much pain and disability.

3. In compound dislocations or fractures into joints, especially the elbow and shoulder.

Barwell gives the following tables of contrasts :—

CONDITIONS UNFAVOURABLE TO EXCISION.	CONDITIONS FAVOURABLE TO EXCISION.
GENERAL.	
1. Co-existence of any internal organic disease, chiefly tubercles of the lung or mesentery, albuminuria, lardaceous enlargement of the liver or spleen, simultaneous affections of any other important joint, or of the spine.	Absence of all internal disease; or of simultaneous affections of other joints, or of the spine.
2. Apparent dependence of hectic fever upon some cause other than the local disease.	Dependence of the hectic fever solely upon the local disease.
3. Adjacent abscesses extending a great way from the original seat of the disease, more especially if running upwards from the affected joint.	Restriction of morbid changes to a locality not far from the original seat of disease.
4. The more rapid and profuse the suppuration the less favourable the case.	The more chronic and the less in amount be the suppuration the more favourable is the case.
LOCAL STATE OF THE BONE.	
<i>Prior to the commencement of the operation.</i>	<i>Prior to the commencement of the operation.</i>
External caries, or suppuration of the periosteum, extending a considerable distance from the joint end; whether this be primary or produced by spreading of the inflammation.	Restriction of morbid action to a locality not far removed from the joint end.
<i>After removal of a slice of bone.</i>	<i>After removal of a slice of bone.</i>
Presence of extravasations, particularly if multiple and in large blotches.	Absence of extravasations, or their appearance only in a few small spots.
Diffusiveness of inflammation, more particularly if it be suppurative.	Circumscription of the inflammation, whether suppurative or no.
Absence of all bony thickening; presence of diffused softening.	Presence of bony thickening, more particularly if it be not scattered, but either total or circumscribing any softening, or other low form of inflammation that may affect the bone.
Softening of the whole, or nearly the whole, section surface, particularly if combined with diffuse suppuration, or if the granulation tissue be straw-coloured or greenish.	Absence of great amount of softening or suppuration; florid, healthy granulations, circumscribed by indurated tissue.

Erichsen lays down the following conditions of success:—

1. The disease must not be too extensive or the resulting limb will be of less service than an artificial limb. In the lower extremity this is of great importance, as a firm basis of support is required, whilst in the arm the preservation of the complex movements of the hand and use of the fingers are the points to be aimed at.

2. The disease must be in a chronic state. Firstly, because ankylosis may occur, leaving a useful limb; secondly, because in the acute stage an operation is liable to be followed by inflammation and diffuse suppuration of the medullary canal, culminating in phlebitis, myelitis, and other pyæmic conditions.

3. The soft parts about a joint must be in a sufficiently healthy state.

4. The condition of the patient's constitution must be considered, especially the state of the lungs, liver, and kidneys.

5. Age of the patient. In a child, removing the epiphyses of a bone arrests its development, while at the same time natural recovery may occur, as the reparative powers are great. Holmes writes: "In the knee and ankle, excision should hardly be proposed after about forty years of age, and only rarely after thirty."

After early middle age, the mortality of excision rapidly increases. In all cases Esmarch's bloodless method should be used, and strict aseptic precautions.

Excision of the Shoulder Joint.—Cases requiring excision are caries of the head of the humerus, or joint disease which has resisted other modes of treatment. Cases of gunshot injury of the joint, or compound dislocation or fracture involving the joint. In old unreduced dislocation of the head of the humerus, when it is pressing on the axillary nerves. Cases of non-malignant limited tumour affecting the head or upper third of the bone.

Instruments required.—1. Esmarch's tourniquet and elastic bandage. 2. Scalpels. 3. Retractors. 4. Cutting pliers. 5. Butcher's saw. 6. Blunt hooks. 7. Lion forceps. 8. Artery forceps, torsion forceps, tenaculum, and acupressure needles. 9. Linen retractors. 10. Ligatures. 11. Sutures. 12. Key to compress the subclavian artery. 13. Cautery irons. 14. Wire nippers. 15. Absorbent cotton or lint. 16. Sponges (best of absorbent cotton). 17. Bandages. 18. Strapping. 19. Oiled silk. 20. Water-

proof sheet. 21. Ether or chloroform and inhaler. 22. For materials required for aseptic method, *vide* Wounds. 23. A gouge or osteotrite should be at hand, and several probes. 24. Hot water. 25. Spatula. 26. Bistouries and drainage tube.

Operation.—The patient is anæsthetised. (Stage 1.) *Exposure of the Head of the Bone.*—A single straight incision is made—the patient lying on the uninjured side—from a point just external to the coracoid process, downwards along the humerus for five inches. The edges of the wound are to be retracted by assistants, the sheath of the biceps tendon slit up, and the long head of the biceps raised from its groove and drawn to one side so as to be preserved.

(Stage 2.) *Separation of its Attachments.*—An assistant then draws the limb across the chest, projecting the head of the humerus backwards and outwards, whilst the surgeon opens the capsule and divides the muscles attached to the great tuberosity, the limb meanwhile being rotated inwards; next, during rotation of the limb outwards he divides the subscapularis attached to the lesser tuberosity.

(Stage 3.) *Removal of Bone.*—The arm being forced backwards, the head is protruded through the wound and removed by the saw or cutting pliers, the soft parts being protected by a spatula. A good amount of bone, even four or five inches, can be removed in cases of injury with successful results, but the less the better. Fracture or fissure running down from a comminuted part is to be disregarded.

(Stage 4.) *Examination of the Glenoid* and removal of any diseased bone by the forceps, gouge, or osteotrite. Only a few small vessels supplying the anterior fold of the axilla require a ligature. A counter-incision should be made backwards with a bistoury and a probe passed through, carrying a drainage tube to facilitate the escape of discharges. The wound is closed by sutures.

Other Methods.—Where a straight incision appears insufficient, access may be obtained to the joint by raising a flap of the deltoid V-shaped, semilunar, or ovoid, with its base upwards. Moreau used a quadrilateral flap with the base below. Moon preferred an incision carried along the posterior border of the deltoid. Bar-

well thus describes his method: "Choose a place on the acromion a little in front of its outermost point, and begin the incision *on the upper surface* of the process, otherwise the deltoid, which here arises from a sort of ligamentous tissue covering it, cannot be separated enough to afford sufficient space; carry this incision deeply through the muscle to about an inch or an inch and a half from its insertion; take care that the course of the knife be exactly along the muscular fibres so as to avoid dividing any of them." If more room be required, do not cut the muscular fibres, but simply make on the upper surface of the acromion near to, and parallel with its outer margin, a curved incision across the upper end of the primary one, detach the muscle, or rather the fibrous expansion it springs from, and thus a triangular flap may be turned both forward and backward affording ample space.

Sub-periosteal method.—The usual incision is made, and when the bone is exposed all the tendinous and fibrous structures (namely, periosteum, the tendons attached to the tuberosities, and the capsule) are separated from the bone by blunt and sharp raspatories.

After-treatment.—For the first few days the limb is supported on a pillow, with a pad in the axilla, or Stromeyer's cushion. Afterwards the patient can walk about, the hand being supported by a sling, with the elbow free.

Usefulness of the Arm.—After recovery, flexion, extension, and adduction are well performed and the arm is capable of carrying heavy weights. The movement most defective is abduction. Motions of the hand and forearm are perfect. The time required for recovery varies from three to four months.

Excision of the Elbow Joint.—Cases requiring excision: 1. For diseases of the elbow joint which have resisted other modes of treatment and are wearing out the patient's strength; 2. For punctured wounds of the joint; 3. For osseous ankylosis; 4. For compound dislocation or fracture implicating the joint.

Instruments required.—1. Esmarch's tourniquet and elastic bandage. 2. Straight bistoury. 3. Scalpels. 4. Blunt hooks. 5. Retractors. 6. Bone forceps. 7. Butcher's saw. 8. Gouges. 9. Lion forceps. 10. Probes. 11. Artery forceps, torsion forceps, tenaculum, and acupressure needles. 12. Ligatures. 13. Sutures,

14. Absorbent cotton or lint. 15. Sponges. 16. Bandages. 17. Strapping. 18. Oil-silk. 19. Waterproof sheet. 20. Ether or chloroform and inhaler. 21. For materials required for aseptic method, *vide* Wounds. 22. Spatula. 23. Drainage tubes. 24. Raspatory. 25. Hot water. 26. Angular splint to support the arm.

Operation (Maunder).—The patient having been anæsthetised, and laid prone, a perpendicular incision is made at the back of the limb, three or four finger's breadth above and below the olecranon and crossing the point of this process. The knife is next allowed to sink into the triceps muscle and divide it longitudinally into two portions, the inner one of which is the more firmly attached to the ulna, while the outer portion is continuous with the anconeus muscle, and sends some tendinous fibres to blend with the fascia of the forearm. It is these latter fibres that are to be scrupulously preserved. Two points have to be remembered: first, the ulnar nerve, often unseen, must be lifted from its bed and carried over the internal condyle to a safe place; and then the outer portion of the triceps muscle with its tendinous prolongation, the fascia of the forearm, and the anconeus muscle must be dissected up in one piece, as it were, sufficiently to allow of its being temporarily carried over the external condyle of the humerus. The olecranon will be first exposed, and should be removed by the bone forceps. By forcibly bending the joint, pushing the forearm upwards and dividing the ligaments with the point of the knife, the interior of the articulation will be freely exposed. A spatula is passed between the soft parts in front of the joint and the displaced bones after these have been projected, and the extremities of the humerus and of the radius and ulna removed by the saw. The humerus is divided just above epicondyles, the ulna at the base of the coronoid, and the radius through its neck.

Other Methods.—A H- or T-shaped incision may be used if more room be required, or a semilunar one with the convexity downwards.

After-treatment.—Few vessels, if any, require a ligature. A drainage tube is inserted, and the arm laid on a pillow nearly in the extended position. If thought advisable, an angular splint may

be used. Passive motion should be commenced from ten to twenty days after the operation, to prevent osseous ankylosis.

Excision of the Wrist Joint.—Cases requiring the operation are disease of the carpal bones and injuries to the joint. The instruments are the same as in the preceding excision.

Operation (Lister).—A tourniquet is applied to prevent oozing, which would conceal the state of the bones. All adhesions are broken down by freely moving all the articulations of the hand. An incision is made "from about the middle of the dorsal aspect of the radius on a level with the styloid process downwards and outwards towards the inner side of the metacarpo-phalangeal articulation of the thumb; but on reaching the line of the radial border of the metacarpal bone of the index finger, it is carried down longitudinally half the length of that bone." The extensor carpi radialis brevis tendon is divided in the incision. The soft parts at the radial side are to be carefully dissected up, and the tendon of the extensor carpi radialis longior divided at its insertion. The cut tendons and the extensor secundii inter-nodii tendon and the radial artery are to be pushed outwards out of the way. The trapezium is then separated from the rest of the carpus by means of cutting forceps applied in a line with the longitudinal part of the incision. The removal of the trapezium is reserved until the rest of the carpus is taken away. The soft parts on the ulnar side of the incision are now dissected up as far as may be convenient, the extensor tendons being relaxed by bending back the hand. The knife is next entered on the inner side of the arm, two inches above the end of the ulna, immediately anterior to the bone, and is carried downwards, between it and the flexor carpi ulnaris, and on in a straight line as far as to the middle of the fifth metacarpal bone on its palmar aspect. The tendons and soft parts on the dorsum of the carpus are now to be completely raised, and the tendon of the extensor carpi ulnaris cut at its insertion into the fifth metacarpal bone, and dissected up from its groove in the ulna, care being taken to avoid isolating it from the integuments, which would endanger its vitality. The extensors of the fingers are then rapidly separated from

the carpus, and the dorsal and internal lateral ligaments of the wrist divided, but the connections of the tendons with the radius are purposely left undisturbed. In front, the flexor tendons are separated from the carpus, the knife being kept close to the bone to avoid wounding the artery or nerve. The pisiform bone is to be separated and left attached to the tendon of the flexor carpi ulnaris, which is not to be cut. While this is being done the knife is arrested by the process of the unciform bone, which is clipped through at its base with pliers, and care must be taken not to cut below the base of the metacarpal bones, for fear of wounding the deep palmar arch. The anterior ligament of the wrist being now divided, the junction between the carpus and metacarpus is divided by cutting pliers, and the carpus extracted through the ulnar incision by strong sequester forceps, any bands which retain it being touched with the knife. By forcible eversion of the hand the ends of the radius and ulna can be protruded at the ulnar incision. If they appear sound, or only superficially affected, the articular surfaces only are removed. The ulna is divided obliquely with a small saw, leaving the base of the styloid process, and removing all the cartilage-covered portion. A thin slice of the radius is then cut so as only just to remove the cartilaginous surface, and the articular facet on the inner side clipped away with bone forceps. The metacarpal bones are then treated on the same principle, their ends sawn off, and articular facets clipped by the bone forceps applied longitudinally. The trapezium is seized by forceps and dissected out, taking care to avoid wounding the radial artery on the outer side, and the tendon of the flexor carpi ulnaris which lies in its groove. The metacarpal bone of the thumb is then pared. Lastly, the articular surface of the pisiform is clipped off, the rest of the bone being left, if it be sound. The radial incision is stitched closely throughout, but the ulnar one is kept open for drainage.

After-treatment is most important. The principles are: 1. Early and free movements of the fingers; 2. Secure fixation of the wrist. The first is obtained by passive motion, commencing on the second day; the second by a splint, supporting the forearm and hand, the fingers

being held in a semiflexed position by a large pad of cork attached to the splint. The anterior part of the splint below the fingers may be gradually shortened, but the patient must wear it for months.

Other Methods.—Langenbeck uses a single free incision over the dorsum of the wrist, along the centre of the metacarpal bone of the index finger; through this opening the carpal bones and the base of the metacarpus can be exposed and turned out without wounding the tendons. Mayo Robson recommends an incision, starting at the back of the hand over the proximal end of the third metacarpal bone, and running vertically upwards for about $1\frac{1}{2}$ inches, passing over the centre of the groove in the back of the radius, which lodges the common extensors of the fingers. After dividing the skin, superficial fascia and deep, the extensor communis digitorum is seen, the knife being carried down to the bone between the tendon of the index finger on the outer side and the tendons of the three inner fingers on the inner side. The incision can be prolonged downwards and upwards if necessary. The sides of the wounds are relaxed, and, with raspatory and knife, the joint can be exposed, and the diseased bone removed. A counter-opening is made close by the extensor tendon of the little finger for drainage.

Excision of the Hip Joint is usually performed for disease of the femur, or pelvis, which rest, time, fresh air, and good diet have failed to arrest, or for certain gunshot injuries.

A report of a committee of the Clinical Society as to the indications for operating is briefly as follows:—

(a) 1. Necrosis of the head of the femur, and its conversion into a loose sequestrum. 2. The presence of firm sequestra either in the head or neck of the femur, or in the acetabulum. 3. Extensive caries either of the femur or of the pelvis, leading to prolonged suppuration and the formation of sinuses. 4. Intrapelvic abscess following disease of the acetabulum. 5. Extensive and old standing disease, and ulceration of the articular cartilages, with persistent suppuration. 6. Displacement of the head of the femur on the dorsum illi, with chronic sinuses and deformity.

(b) Excision should be performed in cases of suppuration, when enlargement of the liver, or albuminuria, indicating

the presence of degeneration of the viscera, is detected.

(c) When suppuration continues free, fresh sinuses are formed, or extensive burrowing is in progress, and the patient is losing ground, in spite of treatment by rest and free drainage.

(d) In disease of the pelvis, to provide efficient drainage for suppuration, which may sometimes be detected near the floor of the acetabulum by the finger passed into the bowel, though pelvic disease renders the prospect of recovery under whatever treatment is adopted, doubtful. The committee consider that complete rest and extension, with the withdrawal of matter, should always be first patiently tried, and only if this plan do not succeed, should operative measures be resorted to.

Instruments required.—1. Esmarch's tourniquet and elastic bandage. 2. Scalpels. 3. Strong bistoury. 4. Probe pointed bistoury. 5. Raspatory. 6. Long probes. 7. Adams' saw. 8. Chain saw. 9. Bow saw. 10. Gouge. 11. Sequestrum forceps. 12. Lion forceps. 13. Artery forceps, torsion forceps, tenaculum and acupressure needles. 14. Chisels. 15. Bone forceps. 16. Sutures. 17. Ligatures. 18. Retractors. 19. Blunt hooks. 20. Absorbent cotton or lint. 21. Sponges. 22. Bandages. 23. Strapping. 24. Oiled silk. 25. Mackintosh sheet. 26. Ether or chloroform and inhaler. 27. For materials required for aseptic method, *vide* Wounds. 28. Spatula. 29. Drainage tubes. 30. Hot water. 31. Splint, or weight and pulley.

Operation.—The sinuses which exist ought to be made use of if possible. (1st Step.) *The incision.*—When the surgeon can choose, he should make a straight incision parallel with the bone, extending from the top of the great trochanter downwards, for three inches, and this is prolonged forwards from the same point in a curved direction, with the concavity forwards, towards the head of the bone; this latter incision must be of limited extent to avoid the anterior crural nerve and femoral vessels. The incision is carried boldly down to the bone.—(2nd Step.) *Clearing the bone.*—The limb is forcibly adducted, rotated inwards, and pushed upwards by an assistant, and the soft structures, particularly at the anterior and lower part of the head, separated by a probe pointed bistoury.—(3rd Step.) *Removal of bone.*—

The head, neck, and great trochanter, should be fully exposed, and an Adams' or chain saw applied below the great trochanter. Gant recommends that instead of dislodging the head of the bone, it should be excised *in situ* by passing a long narrow-bladed saw down to the line of the section, as the wound is smaller, and the parts less disturbed. The acetabulum must be examined, and all diseased portions removed by cutting pliers, gouge, saw, etc.

After-treatment.—The wound must be dressed in a suitable manner, and drainage tubes inserted; then extension should be applied by means of the long bracketed splint, Bryant's double long splint, or weight and pulley, and lateral sand bags, or the wire cuirass. As soon as the wound has healed, *i.e.*, from six to eight weeks, the patient may sit up, and get about with crutches and some hip splint; the average duration of treatment is three months.

Other Methods.—A T-shaped incision, or a semilunar one, skirting three sides of the trochanter, may be used. Barwell prefers a simple semilunar incision, beginning half an inch, or more, above the anterior angle of the trochanter, sweeping round the back of that process, then swerving forwards again, and terminating over the front margin of the femur. The distance between these two anterior horns would be, in the adult, about 4 inches, in the child, $2\frac{1}{2}$ inches. The flap is dissected deeply, and thrown forwards, so as to leave the bone covered only by its tendinous expansions. The gluteus medius is seen running obliquely from the pelvis to the anterior margin of the trochanter. The knife is now sunk to the depth of half an inch behind the process, about the middle, as regards length, and being made to skirt the bone very closely, passes to its upper edge, and onward to the margins of the gluteus tendon; being changed from a perpendicular to a horizontal position, laying flat on the outer face of the trochanter, it is passed under the edge of the muscle, and while descending, detaches the tendon from the bone. Next, the digital fossa is to be sought, and the obturator externus and internus divided in it. The surgeon presses the tendons outwards with his left forefinger, and glides it up towards the acetabulum until he feels its margin;

keeping the finger on this place, he guides the scalpel to this spot, sinks it into the joint, and sweeps it round this cavity.

Sayre uses an incision four to eight inches in length, commencing at a point midway between the anterior superior spine of the ilium and the top of the great trochanter, then drawn in a curved line over the ilium, making an incision across to the top of the great trochanter, then carries it midway between the centre and the posterior border of the trochanter, and completes it by carrying the knife forwards and inwards. He preserves the periosteum, stripping it off with a periosteal elevator.

Heyfelder uses an incision beginning a little above and behind the great trochanter, towards which it passes in the line of the fibres of the gluteus maximus, and then curves around and behind the trochanter, downwards and a little backwards, terminating over the linea aspera between the insertions of the gluteus and vastus externus.

Excision of the Knee Joint is performed :
1. In cases of extensive disease and disorganisation of the joint with destruction of the articular cartilages, and, perhaps, dislocation, but without the onset of hectic or emaciation; 2. To remedy faulty angular osseous or ligamentous ankylosis; 3. For gun-shot or other injuries. The excision should always be complete, the patella being removed whether affected or not. The disease must be *limited in extent*, as it affects the tibia and femur, so that a sufficiently wide bony surface remains to support the weight of the limb, without this being too much shortened to be useful. In children under ten or twelve, excision should not be performed if the disease extends beyond the limit of the epiphysial cartilages. Among the various incisions recommended the best seems the semilunar.

Instruments required.—1. Esmarch's tourniquet and elastic bandage. 2. Scalpels. 3. Strong bistoury. 4. Bow saw. 5. Probe pointed bistoury. 6. Probes. 7. Gouge. 8. Osteotrite. 9. Chisel. 10. Artery forceps, torsion forceps, tenaculum, and acupressure needles. 11. Bone forceps. 12. Ligatures. 13. Sutures. 14. Retractors. 15. Blunt hooks. 16. Sponges. 17. Absorbent cotton or lint. 18. Bandages.

19. Strapping. 20. Oiled silk. 21. Mackintosh sheet. 22. Drill. 23. Splint and pads. 24. For materials required for aseptic dressing, *vide* Wounds. 25. Spatula. 26. Drainage tubes. 27. Hot water. 28. Chloroform or ether with inhaler.

Operation.—(1st Step.) The patient being anæsthetised, and Esmarch's tourniquet and bandage applied, the knife is entered on one side of the limb at the posterior part of the condyle, and carried across midway between the patella and the tuberosity of the tibia to a corresponding point on the other side. This incision is made right down to the bone throughout, and divides the ligamentum patellæ.—(2nd Step.) The flap is dissected back, the crucial and lateral ligaments divided cautiously, remembering the position of the popliteal artery, and the end of the femur cleaned as far as necessary, the limb meanwhile being held in a strongly flexed position by an assistant.—(3rd Step.) The articular surfaces must now be sawn off with a Butcher's saw, the line of section of the femur being parallel to the articular face, and *not* at a right angle with the axis of the shaft. If necessary, additional slices of bone are removed, until a healthy surface is reached, or the gouge may be used. All the bone normally covered by cartilage must be removed. In children the line of section should not take away all the trochlear surface of the femur, as the epiphysis does not reach this height; it extends to only a little below the attachment of the internal lateral ligament on the one side, and below the origin of the popliteus on the other.—(4th Step.) Next the tibia must be exposed, cleaned, and sawn off about half an inch below its upper surface, in a plane slightly oblique from below upwards, and behind forwards. Finally the patella is taken out. If there be any difficulty in bringing the osseous surfaces together they may be drilled and sutured with wire sutures. Should it be impossible to straighten the limb after removal of the bone, tenotomy should be performed. Morratt Baker uses two steel pins, inserted by means of a movable handle through the head of the tibia into the lower end of the femur for about three inches, to secure coaptation of the osseous surfaces. These two pins cross, forming a St. Andrew's

cross, and are left in until spontaneously loosened.—(5th Step.) Hæmorrhage must then be stopped and the flaps brought nicely together with sutures, after a drainage tube has been inserted through a counter-opening at the back between the external popliteal nerve and the popliteal artery.

After-treatment.—Wire splints lined with leather and provided with a foot piece, an anterior bracketed splint, Gant's splint, or plaster of Paris or paraffin bandages, strengthened with wire splints (for five, six, or more weeks, and then reapplied). To obtain the best results the after-treatment should be continued for six months.

Other Methods.—An H-shaped incision was formerly used, but is now seldom employed. A single transverse incision across the front of the joint immediately below the patella. Lateral incisions without a transverse wound. Fenwick saws the femur in a curved line so as to present a rounded surface, and divides the tibia from behind forwards in a concave manner, to fit the rounded extremity of femur. Herbert Allingham has re-introduced the following operation. A vertical incision is made over the joint, beginning three inches above the patella, and prolonged down to the tubercle of the tibia. The soft tissues are divided down to the bone, and the knee-cap sawn through vertically, dividing it into two lateral halves, each half with half the quadriceps tendon, and the ligamentum patellæ are slipped well to the side of the joint, which is then excised. If the patella is healthy, this is united, after incision by catgut sutures; if diseased, remove it and join the halves of the tendon with sutures.

Excision of the Ankle Joint.—Cases requiring excision: 1. In some compound dislocations, where the tibia and fibula are protruding; 2. For disease of the ankle joint; 3. In certain cases of gunshot injury. Instrument required are the same as for the preceding operation, with the addition of a metacarpal saw.

Operation (Hancock).—Commence the incision about two inches above and behind the external malleolus, and carry it across the instep to about two inches above and behind the internal malleolus. This incision should merely divide the skin. Reflect the flap so made and next

cut down upon the external malleolus, carrying your knife close to the edge of the bone both behind and below the process, dislodge the peronei tendons, and divide the external ligaments of the joint. With the bone forceps cut the fibula through an inch above the malleolus, remove this piece of bone and divide the inferior tibio-fibular ligament, now turn the leg and foot on the outside. Then carefully dissect the tendons of the tibialis posticus and flexor communis digitorum from behind the inner ankle. Carrying your knife close round the edge of this process, detach the internal lateral ligament, then grasp the leg with one hand and the dorsum of the foot with the other, forcibly turn the sole of the foot downwards, dislocating the lower end of the tibia and protruding it through the wound, where it can be readily sawn off. The upper surface of the astragalus must now be removed by a small metacarpal saw. Replace the parts *in situ*, close the wound on the inner side and front, leaving the outer side open, apply a suitable dressing and place the foot on its outer side on a splint. Osseous ankylosis is generally obtained.

Other Methods. — Lateral incisions (Barwell). Single incision over the external malleolus (Buchanan).

Liebricht's method consists in making a transverse superficial incision, beginning at the middle of the posterior border of one malleolus and ending at a corresponding point on the opposite side. The tendo Achillis is cut across, and a second incision made along its inner border. The posterior tibial vessels and nerve, and the tendons which pass behind the malleoli, are then easily freed and drawn aside. The joint is opened from its posterior and external aspect, and the bones examined and excised. After which the ends of the tendo Achillis are united by sutures. Mayo Robson advises an anterior longitudinal incision, external to the extensor proprius pollicis and anterior tibial vessels, but internal to the

extensor longus digitorum. The sides of the wound are retracted, and on dividing the external and internal lateral ligaments, and extending the foot forcibly, the astragalus can be removed and the ends of the tibia and fibula excised *in situ*, or made to project, and removed with a Butcher's saw. A counter-opening for drainage is made by the side of the tendo Achillis.

Subcutaneous Section of the Neck of the Femur (Adams) is performed in cases of faulty ankylosis of the hip. A long tenotomy knife is entered a little above the trochanter, and passed down to the neck, opening the capsule freely; a narrow saw is entered through the wound, and the neck divided from before backwards. If the head of the bone be destroyed, shown by the amount of shortening and the duration of the disease, Gant advises that the operation should be performed just below the trochanter, also in cases accompanied by the formation of osteophytes round the neck of the femur. He writes; "I grasp the front of the thigh with the left hand below the trochanters, and turn the mass of muscles somewhat outwards, planting my thumb rather below the outer side of the femur to mark the point of incision. A stout tenotomy knife, set in a long handle, is entered at that point and passed down to and over the femur, so as to make a transverse line across the bone; then the knife is withdrawn, and still keeping the thumb in position not to lose the track of the narrow subcutaneous incision, a thin narrow-bladed saw, set in a long handle, is entered at the same point, and passed along the track of the wound over the femur, which is then readily divided." A compress of lint is applied, and the limb brought into proper position. Gant lays stress upon the points that air should not be admitted, and the femur should be accurately sawn through and not fractured.

SECTION VI.

INJURIES AND DISEASES OF THE MUSCULAR, VASCULAR,
NERVOUS AND ABSORBENT SYSTEMS.

CHAPTER XVII.

INJURIES AND DISEASES OF MUSCLES AND BURSÆ.

Sprains or Strains of muscle are of frequent occurrence, and are accompanied by pain, swelling, stiffness and difficulty in moving the part. They may be followed by atrophy or paralysis.

Treatment consists in rest and compression by paraffin or india-rubber bandages applied over cotton wool, and rubbing the part with some stimulating liniment. To relieve pain, dry cupping is serviceable, and acupuncture or scarification. Subsequently galvanisation, followed by faradisation, blisters, and massage.

Rupture of muscles by their own action, or occasioned by violence from without, is not unfrequently met with, though the power of resistance of a healthy muscle is enormous, it tearing less readily than bone or tendon. The solution of continuity occurs either in the muscular substance itself; at the junction of the fleshy fibres with the tendon; through the tendon; or, lastly, at the point where this is inserted into the bone. The accident is most common in middle-aged persons, also in cases of degeneration of the muscles after fevers, as typhoid, scarlet fever, yellow fever, etc. In rupture of a muscle by its own action, it must be taken unawares, for no voluntary act, however violent, will rupture a muscle. Violent muscular spasms, as in tetanus or vomiting, occasionally produce this lesion.

Symptoms.—1. Sudden inability to perform the accustomed motions, with pain, and a sensation of something having given way. 2. A hollow, due to the muscle retracting, and perceptible on external examination. 3. Extravasation of blood. 4. Weakness or atrophy may occur later on.

Seats.—The tendo Achillis, gastrocnemius, vasti, rectus, and adductors of the thigh; extensor brevis of the foot; biceps, triceps, and deltoid in the arm; pector-

alis major; and the recti muscles of the abdomen are the most common instances. When the rectus abdominis is ruptured, symptoms of intestinal obstruction or peritonitis may supervene.

Union takes place by effusion of lymph from the torn vessels into the sheath of the muscle (which remains almost intact). The plastic lymph becomes organised into a granulation tissue, which develops in the course of a week into a dense fibrous tissue closely resembling tendon. This tissue is formed, whether the lesion is through the muscular fibres or through the tendon.

Treatment.—Maintain perfect rest and relax the muscles by attention to the proper position, so as to approximate the torn ends. The part is retained in this position by bandaging with plaster of Paris, or rubber bandages, until union is effected. If much blood is effused, apply evaporating lotions, but never make an incision. For the tendo Achillis the foot is extended, and the knee flexed, by the patient wearing a slipper attached by a band (fixed to the heel) to a buckle and strap fastened above the knee.

Diseases of Muscles.—Muscular tissue is not often the seat of primary disease. Atrophy and rheumatic affections are common. Syphilitic fibroid induration, syphilitic gummata and abscess are also met with. Ossification is rare. Cancer, either encephaloid or scirrhus, may present itself as a secondary affection, but never as a primary. Sarcoma, hydatid, fibroma, enchondroma, angioma, myxoma, and lipoma have also occurred. These must be treated on ordinary principles.

Hernia of Muscle, from the protrusion of muscular substance through an opening in the enveloping aponeurosis, may take place as the result of traumatic injury.

Symptoms.—Fulness during contrac-

tion of the muscle, disappearing on relaxation. Movement is painful in acute cases. In chronic stages, if the finger be kept on the situation of the swelling, the opening can be detected, and the muscle fibre rising up into the aperture on contraction.

Treatment.—Rest and well applied pressure; if necessary, close the hole with sutures.

Wounds of Tendons are treated by suture with animal ligatures, as carbolised catgut, chromicised catgut, kangaroo tendon, etc.; with attention to position, splints being applied if necessary. In old-standing cases, under aseptic precautions, cut down on and pare the divided ends, and suture as before mentioned.

Dislocation of Tendon from its sheath may result from a sudden twist. The usual situations are the tibialis posticus and peronei tendons, as they pass behind the ankle; the long tendon of the biceps; and the tendons of the forearm, etc.

Symptoms.—Pain, loss of voluntary movement. The tendon will be felt in its new situation and a hollow in its normal position, if not obscured by swelling.

Treatment.—The tendon is easily replaced, but with difficulty retained in position. Pads, strapping and splints may be tried, and if unsuccessful, subcutaneous tenotomy to secure its adhesion to the sheath.

Diseases of the Sheaths of Tendons.
Ganglion.—This is a tumour connected with the sheath of a tendon, usually met with in the hand. It may be “simple” or “compound,” and generally results from chronic irritation and repeated overstrain of the sheath.

Single Ganglion consists of a cyst connected with the sheath of a tendon, and containing either a yellow watery fluid, or, more frequently, a gelatinous substance. Sometimes, and probably nearly always at its commencement, it freely communicates with the cavity of the sheath, but later this aperture has usually closed.

Characters.—It forms a smooth, elastic, globular, and tense tumour, not adherent to the skin, and situated on one of the extensor tendons at the back of the wrist, (occasionally on the front, attached to the flexor tendon), or front of the ankle, now and then behind the external malleolus, originating from the peronei tendons. It does not produce

inconvenience or pain, but when large it may occasion pain and weakness by pressing on the adjacent nerves, and is unsightly. In some cases translucency is apparent.

Diffuse or Compound Ganglion is met with in the palm of the hand, dorsum, sole, or the inner side of the foot. It is formed by a dilatation of the sheath of a tendon, from overwork or sudden exertion.

Characters.—It is of a larger size than the simple variety, and of an irregular shape, and contains a watery, clear, yellow-coloured fluid, with occasionally melon-seed or rice-like bodies floating in it. The sheath is thickened, and lined by a red and vascular membrane. When in the hand it always extends above the annular ligament, above and below which the fluid can be made to fluctuate.

Treatment.—When simple, if recent, blisters, iodine ointment and rest on a splint; if of some standing, the cyst should be ruptured by pressure with the two thumbs, striking it with a book, or continued pressure by means of a coin wrapped up in lint and strapped firmly on the part. If these means fail, a tenotome should be introduced obliquely through the skin, the sac opened, and the wall well torn by the point of the knife, its contents being pressed out, and a pad applied, fixed by a bandage. In some cases a seton may be passed through it. As a last resource, it may be dissected out, but this is liable to excite inflammation. When compound, a seton may be passed, or tinct. iodi. injected, or incisions made in vertical directions over all the affected tendons, both above and below the annular ligament, and the cavity washed out with iodine water; or lastly, the tumour may be carefully dissected out under strict aseptic precautions.

Inflammation of the Sheaths of the Tendons is a common, and often a grave occurrence. Three forms are met with: 1. Acute septic or suppurative thecitis; 2. Acute simple thecitis or tenosynovitis; 3. Chronic thecitis.

1. Acute septic or suppurative thecitis follows injection with septic matter through slight wounds, as a prick or scratch. It is frequent in the hand, where it occasions paronychia tendinosa, or thecal abscess, one kind of whitlow.

Symptoms.—Swelling, and intense

agonising pain in the finger, shooting up the arm. Redness and tension. Feverishness, ushered in by a rigor, then great constitutional disturbance, exhaustion, and hectic. The palm becomes affected, and the hand and forearm immensely swollen. Large abscesses form, implicating the connective tissue planes of the limb. Necrosis of the tendons, pyæmia, disease of contiguous bones and joints, and uncontrollable hæmorrhage may ensue if the case be untreated.

Treatment.—When the patient is seen early, leeches, belladonna and glycerine, hot fomentation, and immersion of the part in hot water, alternately with poultices. Keep the bowels open, and give liq. ferr. perchlor. mxx every four hours. If there be no relief in twenty-four hours, or as soon as suppuration is diagnosed, make a free incision along the centre of the affected finger, and apply lin. iodi. over the skin in the line of the vessels of the forearm. When the palm is attacked, make further incisions in the middle line of the finger, and above a transverse line drawn across the hand from the cleft of the thumb, to avoid the palmar arches, continue the poultices and fomentations. Opium and alcohol should be freely given. If the forearm be involved, the usual treatment for cellulitis must be employed, and when the joints are much diseased, amputation.

2. Acute simple thecitis or tenosynovitis.

Causes.—Strains, wounds, bruises, rheumatism, or extension of inflammation from a contiguous joint.

Symptoms.—1. Pain along the tendon, increased on pressure or motion. 2. Puffy swelling along the line of the tendon. 3. Weakness. 4. Crepitation, distinct, like rustling silk, and quite different from the crepitus of fracture or anything else; it is due to the rubbing together of the walls of the synovial sac, roughened by exudation. 5. Fluctuation.

These injuries are apt to be very slow in repair, leaving stiffness (from adhesion between the sheath and its tendon), weakness, and liability to fresh inflammation on slight injury, lasting for years.

Treatment.—Leeches and blisters at the commencement, followed by rest and compression with a rubber bandage or strapping.

3. Chronic thecitis.—*Causes.* Following the acute form, sprain, rheumatism.

Symptoms.—Similar to the preceding. Loose melon-seed bodies may be present in the sheath. This form is prone to give rise to disease in the neighbouring joint.

Treatment.—Constitutional is that for rheumatoid arthritis, which is often present. Locally, rest, counter-irritation by blisters or iodine liniment. Strapping or elastic bandage. Subsequently massage and sulphur baths. Any movable bodies are to be removed with aseptic precautions.

Diseases of Bursæ.—The following are the principal seats of bursæ: behind the angle and on the symphysis of the lower jaw; on the angle of the thyroid cartilage; on the acromion; the external and internal condyles of the humerus; over the olecranon; the styloid processes of the radius and ulna; on the dorsal and palmar surfaces of the metacarpophalangeal joints; on the anterior superior spine of the ilium; the great trochanter; the ischial tuberosity; the lower, superior, and external parts of the patella; on the condyles of the femur; the tubercle of the tibia; the malleoli; os calcis; dorsal surface of the toes; and on the plantar surface of the heads of the first and fifth metatarsal bones. Under the deltoid, gluteus maximus, latissimus dorsi, psoas, and in the ham.

Bursæ are only large constant lymph spaces in the connective tissue, and are connected with the neighbouring lymphatics, and thus, when inflamed, cellulitis is apt to supervene in the adjacent parts, so, after an injury to the bursa over the olecranon, cellulitis of the forearm is very common. The most frequent seat of disease is the bursa patellæ (housemaid's knee), and this will serve for a type of diseases of bursæ generally. The affections to which it is liable are: 1. Inflammation; 2. Enlargements, fluid and solid.

1. *Inflammation.*—Causes. Predisposing, are gout, lead poisoning, syphilis, rheumatism, blood poisoning, scurvy, Bright's disease. — Exciting. Wounds, bruises, long-continued friction conjoined with pressure, as from kneeling, cold, etc.

Symptoms.—Severe tensive, throbbing, persistent pain, increased by pressure, dependence, or motion. Swelling. Bright redness of the superjacent parts, which

are hot and œdematous. Fluctuation. Fever (101° to 104°). The swelling is *in front* of the patella.

Treatment.—Leeches, ice, evaporating lotions, opium, belladonna and glycerine, with rest on a well padded back splint. If cold applications are not soothing, try warm fomentations or poultices. For the constitutional treatment, *vide* Inflammation. Should resolution not take place, suppuration occurs.

Suppuration.—The abscess which forms discharges itself, usually subcutaneously, resulting in a diffuse abscess, or subfascially giving rise to cellulitis; as a rare event it may burst into the joint. In other cases the inflammation may spread from the bursa to the adjacent bone.

Treatment.—A free incision must be made over the patella, under aseptic precautions, for in a certain number of cases this bursa may communicate with the knee joint, counter openings are established if necessary, and drainage tubes inserted.

2. *Enlargements.*—The bursa may be distended with a clear straw-coloured fluid.

Symptoms.—An oval or rounded tumour, occupying the situation of the bursa, in a place liable to constant pressure. The skin is thickened, but sometimes thinned, and of a natural colour. Often a distinct friction sound and feeling can be produced on handling the swelling.

Treatment.—Rest, repeated painting with lin. iodi. Strong pressure with a bandage, the limb being fixed on a splint. Strapping. Blistering. Aspiration or tapping with a trocar. Incision by puncturing the bursa with a lancet or small

knife, withdrawing its contents, and bringing the walls accurately together with plaster, combined with rest in bed. Subcutaneous incision by passing a long-bladed tenotomy knife for some distance under the skin, and dividing the bursa freely, but subcutaneously. Passing a seton, and lastly, injection of iodic (tr. iodi. and water, equal parts), which is allowed to remain in two minutes; this is associated with rest on a splint.

Sometimes the bursa contains movable bodies like melon seeds, its coats being thickened, and the contained fluid dark from mixture with blood. These bodies are altered fringes of synovial membrane, or lymph, and present a crackling sensation on handling the tumour.

Solid Enlargement is formed by fibrous deposit, arranged in concentric layers, and seems to be most common in syphilitic individuals.

Treatment.—Excision under aseptic precautions. A free incision is made over the middle line of the tumour, and the skin dissected freely back on each side. The upper portion of the tumour is separated from the periosteum of the patella, and in removing the lower part, which is connected with the capsule of the joint, the cellular adhesions which attach the tumour must be put on the stretch and divided with the edge of the knife turned *towards* the tumour. At each side of the ligamentum patellæ, the synovial membrane is in close approximation to the tumour, and should be carefully avoided. A drainage tube is inserted, and a suitable dressing applied. In three cases in which I have performed this operation, the result has been exceedingly satisfactory.

CHAPTER XVIII.

INJURIES TO ARTERIES.

ARTERIES may be bruised. The effects of the contusion may be transitory, but occasionally inflammation follows, leading to: 1. Narrowing or obliteration of the vessel from contraction of its coats; 2. Plugging of the artery from the formation of a clot, which produces cessation of the pulse below. 3. Ulceration and hæmorrhage.

Rupture may be complete or partial. In the latter case the internal and middle coats give way, whilst the tougher external one remains intact; this may lead to gangrene (but this is less likely than when an artery has been ligatured), occlusion of the lumen, or aneurism. When complete, the accident is due to great violence, there is but

little hæmorrhage owing to retraction of the internal and middle coats, and the external being drawn down and twisted over the aperture. Should the rupture be subcutaneous, extensive extravasation or traumatic aneurism is produced.

Wounds are accompanied by more or less hæmorrhage varying in amount according to the size and direction of the cut. If the wound be longitudinal the edges do not gape much, but if transverse or oblique there is considerable retraction from the state of tension in which the vessel is normally placed: that this is the cause is shown by the fact that if an artery be dissected out and removed from the body the edges of the wound are not separated to a great extent. When an artery is completely divided less bleeding ensues than when the injury is incomplete, as in the latter case the necessary changes in the coats of the vessel cannot take place. The complete division of a partially severed vessel is often sufficient to stay the bleeding, as in the artery of the frænum, superficial temporal, etc.

Arterial Hæmorrhage.—When an artery is wounded the blood flows from it with some force, in a bright scarlet stream, which generally issues in successive pulsatory jets, synchronous with the contraction of the left ventricle; but in small vessels, or when the blood is poured out at a distance from the surface, the stream may be continuous. Pressure applied to the main trunk between the wound and the heart will cause the hæmorrhage to cease. When the blood is unable to escape through an external opening and is sent forth into the cellular tissue of a part, it is termed an Extravasation.

Spontaneous Arrest of Bleeding.—1. Increase in the coagulability of the blood. As the blood flows, its power of eoagulation becomes greater, this being sufficient in small vessels to stop the hæmorrhage.

2. Weakening of the heart's action and diminished force of the stream. This assists powerfully in aiding the formation of a clot, and procuring closure of the wounded vessel, by allowing time for a coagulum to develop.

3. Changes in the coats of the vessel. These consist of a *retraction of the vessel within its sheath*, due to the fact that all arteries are elastic tubes in a state of tension, leaving room for the production

of the "external clot," which is also aided by the rough surface of the sheath. *Circular contraction* of the coats simultaneously occurs, diminishing the lumen of the vessel considerably, and favouring the formation of the "internal clot." The circular contraction is most marked in the smaller arteries, as in these the muscular coat is most developed. The internal clot is formed of laminæ with a spiral arrangement. It is dark, composed of fibrin with white and red corpuscles, firmly fixed by its base to the margins of the aperture, and having its apex and sides free. This clot is of immense importance in the subsequent changes necessary for the permanent closure of the artery.

Permanent Occlusion takes place by adhesive inflammation accompanied by continued contraction of the coats of the vessel. Lymph is poured out within and on the exterior of the artery; it is effused from the cut surface of the internal and middle coats, and forms the base of the internal clot which becomes gradually organised. The coloured corpuscles by degrees lose their shape and colouring matter, and gradually unite with the eoagulated fibrin. The latter may be converted into connective tissue by proliferation of the white corpuscles contained in it, or by invasion of leucocytes derived from the wall of the vessel. The internal coat contracts, embracing the clot firmly. The final step is the obliteration of the artery up to its first collateral branch, and its transformation into a dense fibrous cord.

Constitutional Effects of Hæmorrhage vary in accordance with the quantity of blood lost, the size of the vessel, the rate at which it is poured out, and the patient's strength to support the loss. If a large artery be wounded, death may result immediately; should the case be not so serious as this, a state of syncope follows, with nausea, profuse, cold, clammy sweats, coldness and ghastly pallor of the surface, gasping breathing, and tossing of the arms, intense unquenchable thirst, great restlessness and agitation, vision and audition fail, and the pulse is feeble, or may be absent at the wrist. If the patient rally he may recover without any subsequent harm, but more often a state of anæmia remains with dropsy. Irritative fever is a common sequel, the pulse being very

frequent, with a jerking, thrilling sensation, great thirst and restlessness, throbbing of the temples, headache, palpitation, noises in the ears, sleeplessness and delirium. Children and old persons bear loss of blood badly.

Treatment.—Arrest the hæmorrhage by suitable means. Rest in bed in the recumbent position; should the patient stand erect, a fatal syncope may result. The head should be dependent, and the extremities may be bandaged from feet and hands to the trunk, to give as good a supply of blood as is possible to the great nerve centres. Hot tea or coffee, and stimulants, given warm, but in moderation. Subcutaneous injection of ether is often of great service. Hot bottles should be applied to the feet, sides of thighs and chest, and to any other convenient place, the patient being covered with warm blankets. Opium is a valuable remedy. When reaction sets in, give plenty of nourishment in a liquid form, little and often must be the surgeon's motto; beef tea, peptonised milk, fresh arterial blood from the heart of the bullock, etc. Salines, as acetate of ammonia, with digitalis and opium, and afterwards small doses of iron. Ice, in small pieces, for the patient to suck, will quench the unbearable thirst. In hæmorrhagic diathesis, tr. ferri perchlor.; oil of turpentine; acetate of lead; hazeline; gallic acid; and ergotine are the best remedies (*vide hæmorrhagic diathesis*). In severe cases, transfusion should be tried.

Transfusion may be immediate, the blood being poured from a healthy person directly into the vein of the recipient without any alteration from the natural state; or mediate, the blood being drawn into a vessel and defibrinated, or otherwise changed, and then injected into the recipient's vein. For the first method, Aveling's or Roussel's apparatus are best; for the second, Wagstaffe's. If blood cannot be obtained, saline fluids, as Dr. Little's, may be used:—

Chloride of sodium gr. lx
Chloride of potassium gr. vj
Phosphate of soda gr. iij
Carbonate of soda gr. xx
Distilled water ʒ xx.

ʒij of alcohol may be added, or chloride of potassium omitted. Three or four pints may be made ready, and kept at a temperature of 98° to 100°. Aveling's apparatus may be used.

Local Treatment of Arterial Hæmorrhage.—The means employed to arrest hæmorrhage are: 1. Pressure; 2. Cold; 3. Actual cautery; 4. Flexion; 5. Ligature; 6. Torsion; 7. Constriction; 8. Forcipressure; 9. Acupressure; 10. Styptics.

1. *Pressure* is an excellent mode of controlling bleeding; as a temporary measure, it is used by means of the tourniquet, or finger (digital), to the main artery, until a ligature can be applied, or other steps be taken. When an artery is bleeding in a wound the hæmorrhage can always be stopped for the time being, if the thumb be fairly placed on the bleeding orifice. A temporary tourniquet can be readily improvised by rolling up a stone in a handkerchief, applying the stone over the artery, and tying the handkerchief over the limb; a stick passed underneath this, and twisted, will give the necessary pressure. For the permanent arrest of hæmorrhage from small vessels which lie on a bone, such as the temporal or palmar arch, a graduated compress, tightly bandaged down over the bleeding point, is very efficient. If a limb be implicated, compresses should also be applied above the wound, along the course of the vessel, and the part bandaged from below upwards, and fixed to a splint. Compression is of service in wounds penetrating deep cavities, as the thorax and abdomen, and lastly, when the blood issues from several vessels at the same time. In some cases, filling the wound with shot is advantageous.

Esmarch's Bloodless Method is a good example of the power of pressure: it consists in applying an elastic bandage to the limb from the distal extremity, to press the blood out, and using as a tourniquet an india-rubber tube or band. Aston Key removed the blood from the limb by stroking it firmly with the hands from the extremity towards the trunk, and then applied the tourniquet.

2. *Cold.*—By exposing the part to the air, pouring a stream of cold water, or applying ice. This is of great service in checking general oozing of arterial blood from a cut surface, and in cases of bleeding from the rectum, vagina, or mouth.

3. *The Actual Cautery* is occasionally, but not often resorted to, in those cases in which the hæmorrhage issues from soft, spongy parts, where a ligature would not

hold, or where it proceeds from many points at the same time, or when a small vessel passes through a bone. If the artery be very small, a knitting needle heated makes a readily accessible and handy cautery. The iron should be applied at a black heat. Paquelin's thermo-cautery is a capital apparatus. In some cases, the galvanic cautery is superior to any other.

4. *Flexion*, of the arm at the elbow, or the leg at the knee, will diminish or stop pulsation in the distant arteries. It is employed in wounds of the palmar arches and forearm, or of the leg and foot. A handkerchief or piece of lint having been placed in the bend of the joint, the limb is flexed until bleeding has ceased, and kept in this position by means of a bandage.

5. *Ligature* is the simplest, safest, and most efficacious means we possess of arresting hæmorrhage. The rules for treating a wounded artery by tying, are : 1. *Apply a tourniquet, cut directly down on the wounded artery, and tie the vessel there ;* 2. *Apply a ligature to both ends of a cut artery, or above and below a puncture in an artery, and then divide the vessel between the ligatures ;* 3. *In wound of an artery near its bifurcation, ligature the main artery and both branches, three ligatures thus being necessary.* The reasons for cutting down on the bleeding point are, that secondary hæmorrhage is prone to come on after some days, when the anastomosing vessels have increased in size, the bleeding proceeding from the lower end of the vessel. Secondly, that it is impossible to know the exact artery from which the loss arises, unless this is sought for in the wound itself. As long as there is an external wound communicating with an artery, whatever the state of the adjacent parts may be, these rules should be followed. In ligaturing an artery that has bled long or repeatedly, care must be taken to apply the ligature directly to the vessel and not to the sheath, which is infiltrated and thickened with coagulated blood. Should the coats of the artery be softened or diseased, the vessel must be isolated until a healthy portion is reached ; or if this be impracticable, a ligature may be applied, including more or less of the surrounding structures. *In primary hæmorrhage from a wound, if the bleeding have ceased, no attempt is to be made to search for the*

vessel. In secondary hæmorrhage, even should the bleeding have ceased, the vessel must always be secured.

Application of the Ligature.—The mouth of the artery must be drawn forwards by a tenaculum, or artery forceps, and tied tightly in a reef-knot. In tying the knot the ends of the ligature should be wound round the fore and middle fingers of each hand, and the thumb extended on them close to the vessel, the ligature being steadily tied without jerking. The ends of the ligature should be cut short in all animal or aseptic ligatures, in others one end is cut short and the other left hanging out of the wound at its most dependent angle. The best materials for ligature are prepared silk or catgut, aorta of ox, kangaroo tendon, whale tendon, well-waxed hempen twine, etc. In cases of emergency use linen thread, tape, or anything else that is handy.

6. *Torsion* is frequently employed instead of the ligature ; it is effected by drawing the vessel from its sheath with a pair of strong serrated forceps, and twisting it in the direction of its axis until resistance ceases (unlimited torsion) ; or by drawing out the vessel and fixing it with one pair of forceps about a quarter of an inch from its extremity, and seizing the end with another pair, twisting it round for about a dozen times until it is torn off (limited torsion). Bryant's torsion forceps is an excellent instrument to use. There is no artery in the body, however large, which may not be safely sealed by this method. The twisted end of the artery is thrown off, and virtually acts like a foreign body.

7. *Constriction.*—Speir, of New York, uses an artery constrictor, consisting of a flattened metal sheath, and sliding steel tongue, with a hook, tight fitting enough to constrict thoroughly, and grooved, and smooth enough not to lacerate the external coats, while it makes complete invagination of the internal ; it is worked by a screw. The artery is seized by a tenaculum or forceps, and the hook placed round the vessel, the tongue is then drawn tightly on the artery by means of the screw, and the vessel drawn up the tube as far as may be necessary ; the instrument is then detached from the artery.

8. *Forcippressure or Crushing.*—Catch forceps, with strong serrated blades, are

employed (Koeberle or Spencer Wells), and completely crush the end of the vessel, breaking across the inner brittle coats.

9. *Acupressure* is especially useful in wounds of the hand and wrist, foot and ankle, where tendons render much interference with the parts inadvisable; it is also serviceable for wounds of the scalp and face. For the introduction of acupressure we are indebted to the late Sir J. Y. Simpson. Pirrie, who was a great advocate of this method, writes: "Being perfectly convinced that acupressure only requires a fair and skilful trial to secure its general adoption, believing, as I do most firmly, that the employment of this method of arresting hæmorrhage is the greatest single improvement in modern times in the treatment of incised wounds, I am anxious to state my decided convictions concerning its merits." He states three methods only are required; that by one or the other of these every vessel which it is possible to reach by ligature may be effectually secured by acupressure. These three methods he terms: 1. Circumclulsion; 2. Torsoclusion; 3. Retroclulsion. For the first, an acupressure pin and a loop of inelastic iron wire are employed; for the second and third, a pin only.

Circumclulsion.—The pin is entered a line or two to one side of the artery, passed below or behind the vessel, its point emerging a little beyond it. The loop of wire is next thrown over the point of the pin, carried across the artery, drawn tight to close the vessel, and secured by a half-twist round the stem of the pin.

Torsoclusion consists in two steps.—(1st Step.) The pin is inserted in the tissues pretty close to the mouth of the bleeding artery, it is then pressed inwards in a direction parallel to the vessel, and its point is caused to emerge to the extent of several lines.—(2nd Step.) This consists in giving a quarter rotation to the pin so as to place its emerged extremity above and at right angles to the artery; in pressing it well down against the small portion of tissue between the instrument and the vessel; and in sending the point for some distance into the tissues beyond the artery, for the purpose of securing the pin in position and of maintaining the twist.

Retroclulsion, so named in consequence of the pin passing ultimately behind

the artery, is satisfactory for vessels of small size. (1st Step.) The pin is entered into the muscular tissue, a little to one side of the artery, held almost flat upon the wound, caused to emerge and passed in front and a little beyond the track of the vessel. (2nd Step.) The head of the pin is made to describe the greater part of a semicircle, so as to be placed nearly flat on the opposite side of the wound, its point is then sent behind the artery, in the contrary direction to that in which it passed in the first step, and pressed on until it is fixed in the tissues adjacent to the vessel.

10. *Styptics* are substances which aid the contraction of the vessels, and rapidly cause coagulation. They are chiefly used in bleeding from spongy surfaces or cavities. The best are hot water, perchloride or sulphate of iron, spirits of turpentine, alcohol, gallic and tannic acids, matico, alum, nitrate of silver, sulphate of copper or zinc, Ruspini's styptic, tincture of hazeline, and the positive pole of the galvanic battery. Styptic colloid is of service for small wounds. Pagliari's styptic is reliable; it is made of tr. benzoin f3viiij, aluminis lb.j, aq. lbs.x. Mix and boil for six hours in a glazed earthenware vessel, stirring constantly, and supplying the loss with hot water. Strain and keep in stoppered bottles. Gross writes: "Hæmorrhage of some of the internal cavities, especially of the uterus, consequent upon the presence of fibroid tumours, is often promptly arrested by the injection of a solution, consisting of 3j of iodine, 3ij of iodide of potassium in 3ij of alcohol, and 3iv of water."

Effects of Ligature.—The immediate effect of the application of a ligature is division of the two inner coats and constriction of the outer.—(1st Step.) Coagulable lymph is effused by the retracted coats, forming an internal clot of conical shape, the base being made up of lymph and fibrin, firmly adherent to the end of the artery; the middle and apex composed of a dark red fibrinous clot, floats loosely, and reaches as high as the first collateral branch.—(2nd Step.) The divided ends of the internal coat are joined by plastic lymph, and also united to the lymph effused in the interior of the vessel round the ligature. By the sixth week the free part of the clot is absorbed, the vessel contracting meanwhile. In fine, the base of the clot is incorporated with

the coats of the artery and transformed into a firm fibrous cord.—(3rd Step.) The outer coat having poured out lymph becomes attached to the sheath, and is thus strengthened, while the ligature occasions sloughing and ulceration of the part included in it, and this is loosened and detached about the eighth day in the smaller arteries, as the radial, and from the sixteenth to the twentieth day in the larger vessels, as the femoral or subclavian.

Collateral Circulation.—After the passage through the main artery has been stopped by a ligature the blood seeks new channels to reach the distal part of the limb; it passes in all directions, entering every vessel, both large and small, and thus sufficient blood is supplied to support life even when large arteries, as the aorta, have been ligatured. The vessels which perform this office are those contiguous to the one ligatured and *on the same side of the body*. The capillaries enlarge first, and then the anastomosing arteries forming an interlaced network; this commences by a general enlargement of the muscular and subcutaneous branches, but in less than a year the blood stream becomes permanently localised in a few of the larger arterial branches adjacent to the seat of the ligature; these auxiliary vessels are sometimes given off by the affected artery, but more often arise from some neighbouring trunk. The injured vessel, as before mentioned, is converted into a fibro-cellular cord, to the first large collateral branch, where it is again pervious, and receives the blood from the collateral currents. If the supply of blood be inadequate gangrene supervenes, or short of this, the limb remains cold and weak. The collateral circulation is most rapidly established in young persons.

Secondary Hæmorrhage. — Causes. Local.—1. Faulty application of the ligature, etc. 2. Presence of a collateral branch in the vicinity of the ligature, especially on the distal side. 3. Wound of a collateral branch. 4. Diseased state of the arterial coats. 5. Morbid changes in the clot. 6. Traction or other disturbance of the ligature. 7. Too tight dressings, or dependence of the part. 8. Absence of retraction in the vessel.

General. — Albuminuria, erysipelas, pyæmia, phlebitis, excited state of the circulation, hospital gangrene, anæmia, debility, hæmorrhagic diathesis, organic lesions of the liver, heart, or other viscera, scurvy, etc.

Symptoms.—The blood trickles forth in small amount at first, but this recurs again and again, until by these repeated losses the patient is exhausted; or in other cases a large quantity may suddenly gush out.

Time at which it occurs.—1. Subsequent to the arrest of primary bleeding and before suppuration has presented itself, that is from the fifth to the sixth day. This is termed intermediary or reactionary hæmorrhage, or the first form of secondary hæmorrhage. It is due to increased vascular action following the initiatory shock, driving the blood forcibly through the arteries and loosening the coagula. 2. A few days afterwards, as the result of disease of the arterial coats, sloughing, or defective repair. 3. When the ligature is separating in consequence of imperfect formation of the clot, or extension of ulceration necessary to detach the ligature. The bleeding is generally from the distal end of the artery. 4. Following the complete separation of the ligature, whilst the wound still remains open.

Treatment.—Subsequent to ligature the patient should be kept quiet, and the bowels and secretions attended to; all stimulants must be forbidden, and no interference with the ligature permitted. Directly secondary hæmorrhage appears means must at once be taken to stop it. When it proceeds from a stump, and is small in quantity, occurring a few days after the operation, position, cold, pressure with a graduated compress, or filling the wound with shot, together with digital compression of the main artery, may arrest it. If the bleeding still continue, seek for the vessel, and tie it; should the ligature not hold, apply the actual cautery. When the hæmorrhage comes from the main artery after the tenth day, pressure by the horse-shoe tourniquet may be first used; if this be unsuccessful, the flaps must be opened up and the vessel sought for and secured. In the case of the flaps being very sloughy, so that a

ligature will not hold at the seat of the bleeding, the main artery should be tied just above the flaps. For hæmorrhage from a vessel that has been tied in continuity, pressure by a compress and tourniquet is applied as a preliminary measure. Should bleeding still continue, if in the extremities, the wound must be opened and the artery tied, if possible above and below the bleeding point, and divided between the ligatures; but when this cannot be effected, secure the vessel higher in its course; and as a last resource amputation may be performed. In the lower limb it is useless to deligate the artery higher up; so if it cannot be ligatured at the bleeding point, amputation should be immediately performed.

Gangrene may present itself after ligation of an artery, from the third to the tenth day.

Causes.—1. Seat. It is especially frequent in the lower limbs. 2. Insufficient supply of blood. 3. Immoderate loss of blood. 4. Mechanical difficulty in the return of venous blood, particularly if the vein be injured during the operation. 5. Erysipelas. 6. Cold; when sufficient care has not been taken to maintain the temperature of the part. 7. Excessive heat by overstimulating the place. 8. Strangulation from bandaging.

Symptoms.—The gangrene is of the moist variety (*vide* Gangrene). The limb assumes a purplish black colour, is swollen and œdematous, and bullæ form.

Treatment.—To prevent mortification, wrap the limb up in cotton wadding, and should the weather be cold apply hot-water bottles close to, but not touching, the part. Friction in the direction of the veins is advantageous. When gangrene has set in no other course is left but to at once amputate at the seat of the ligature.

Traumatic Aneurism is a tumour communicating with a wounded artery, and containing blood which has been poured out through the opening in the coats of the vessel. It is of two kinds, diffuse and circumscribed.

Diffuse Traumatic Aneurism consists of hæmorrhage extravasated in the cellular tissue, beginning along the known site of an artery, spreading between the muscles, extending upwards and downwards, and only limited in extent by the pressure of the neighbouring parts.

It has no sac, its boundary indistinctly formed of coagulated blood, and lymph extends as fresh blood is effused from the vessel.

Causes.—It follows punctures, division, or rupture of an artery; in some cases it is produced by fracture of a neighbouring bone. There is *no* external wound, or so slight a one that the blood cannot escape freely externally. *In fact it is simply a wounded artery with internal hæmorrhage instead of external.*

Symptoms.—A subcutaneous, soft, semi-fluctuating swelling. On palpation a thrill may be perceived, and pulsation felt, and on applying the stethoscope a bruit may be heard. These symptoms can be stopped by pressure on the main artery above the tumour. The branches beyond the seat of injury will not pulsate so strongly as on the healthy side. If the artery be small, or the aperture not freely communicating with the swelling, there may be no pulsation, thrill, or bruit. There are often considerable œdema of the limb, and ecchymosis of the skin. The integuments over the tumour gradually become thin and blue-looking.

Results.—Finally inflammation sets in, and suppuration, with rigors, and the skin becoming red at last bursts, giving rise to the escape of bloody pus; in the meanwhile the artery may be closed, but should this not be the case, gushes of blood occur, which may prove fatal. This danger increases with the size of the aneurism.

Treatment.—Having applied a tourniquet between the tumour and the heart, and the patient being anæsthetised, make a long incision under aseptic precautions, along the line of the artery, and rapidly squeeze out the contents with both hands. The wound is then well washed out with an irrigator; by loosening the tourniquet the bleeding point is discovered, and a ligature applied *above and below it*, or both ends deligated if the vessel be completely severed. If a ligature will not hold, the actual cautery or pressure may be tried, and if this do not succeed, amputation is called for. When the main artery cannot be controlled, as at the root of the neck, a puncture should be made in the tumour large enough to admit one or two fingers, which should be passed on and plug the orifice. The surgeon then

searches for the bleeding vessel with the fingers, and having discovered it, places the finger over the aperture in the artery and prevents further bleeding, while he lays the swelling freely open and turns out the coagula; the vessel is then ligatured above and below the wound. Lidell advises, when arteries are ruptured by fragments of bone, in simple fractures of the leg or thigh, or in reducing dislocation of the shoulder, fixation of the injured part by splints and bandages, and compression on the femoral or subclavian should be tried. If this be not successful, ligature of the artery at a distance from the aneurism, provided the parts can be immovably fixed.

Circumscribed Traumatic Aneurism.—There are two forms of this injury. 1. An artery is punctured or ruptured subcutaneously, blood being effused, and the external wound, if there be one, having been able to close, owing to the skin wound not exactly corresponding to the wounded vessel, from changes in the position of the fascia. The extravasated blood sets up irritation and becomes limited and defined by laminae of condensed connective tissue, forming a circumscribed sac which is filled with layers of fibrin.

Symptoms.—A tumour, of somewhat firm consistence, pulsating, and with a distinct bruit, which ceases on compressing the main artery.

Treatment.—If small, lay it open, turn out the coagula, and deligate the vessel above and below the aperture. If larger and difficult of access, the main vessel should be ligatured at a distance from the aneurism, or pressure applied on the trunk of the artery. 2. In this variety, either the cicatrix left by a wound of an artery gradually yields and forms the aneurism; or if the external coat be alone divided, the internal and middle may protrude, producing the sac; or finally the internal and middle coats may be ruptured, and the external coat alone be moulded into a sac (most common).

Symptoms.—A distinct circumscribed tumour, enlarging, dilating, and pulsating with a distinct bruit.

Treatment.—Pressure at first, and if this fail, ligature applied to the main artery, as near as possible to the sac.

Aneurismal Varix occurs when an artery and vein contiguous to each other have been both wounded, the two vessels cohering closely at the seat of the lesion, as the result of inflammatory adhesion, and the blood passing freely from the artery into the vein at each beat of the heart. The vein is irregularly dilated and tortuous at the aperture, forming a pouch. The veins assume more of an arterial character, and the arteries approach the type of veins in the vicinity of the varix. When recent, the aperture in the vein is a narrow chink; but in old cases, round, with smooth, thickened edges.

Symptoms.—A tumour with distinct pulsation, capable of being emptied by pressure on its walls, or the artery leading to it. It is of a blue colour and oblong shape, possesses a peculiar tremulous motion or thrill, and on auscultation a loud, hissing bruit, resembling the noise of a fly in a paper bag, can be heard. The bruit is continuous in character, but increased at each beat of the heart, and conducted along the vein. The nutrition is impaired, and the limb feels useless. Œdema, cyanosis, ulceration, gangrene, and hæmorrhage occasionally follow from obstruction to the return of venous blood.

Treatment.—As a palliative measure an elastic bandage is all that is necessary. If a radical cure be required, the patient is anæsthetised, Esmarch's bandage applied, the skin dissected off the tumour, and the artery ligatured with prepared catgut above and below the aperture; a third ligature being placed round the communication between the artery and vein. The skin is then replaced, and sutures applied. The aseptic method of dressing should be used.

Varicose Aneurism.—This term is applied when there is a communication between a vein and an artery with an aneurismal sac *between* them. It is a circumscribed traumatic aneurism, connected with an artery, and also with a vein.

Symptoms.—A pulsating and compressible tumour, at first soft and afterwards harder as the blood coagulates; beyond this the vein presents the character of a varix. On auscultation a blowing murmur can be heard, and, in addition, a hissing sound, due to the varix.

Treatment.—Try the application of Esmarch's bandage to the limb, and if unsuccessful, apply the tourniquet, incise the sac freely, and tie the artery above and below it. Digital compression on the main artery at a convenient distance from the tumour and pressure on the spot where the aneurism communicates with the vein is sometimes successful.

CHAPTER XIX.

DISEASES OF ARTERIES.

Hæmophilia or Hæmorrhagic Diathesis is a congenital and habitual disposition to the occurrence of bleeding, depending on some defect of structure in the body. It is most common in the Anglo-Germanic races, and is capable of both direct and indirect transmission. For example, the brother of a bleeder, though unaffected himself, will very likely have bleeders in his family. Most frequently this condition is met with in males, but females who belong to bleeder families, though remaining healthy themselves, transmit the predisposition to their children. The periods at which symptoms most usually manifest themselves are the first dentition, second dentition, and puberty.

The pathology is unknown, but bleeders have transparent, delicate skins, and undue fulness of the subcutaneous vessels, especially the veins.

Symptoms.—The most trifling injury, as the prick of a pin, etc., is apt to be followed by obstinate and uncontrollable bleeding or diffused ecchymoses. Hæmorrhage may also be spontaneous, being preceded by symptoms of congestion and plethora. The bleeding is capillary. The parts most likely to be affected are the mucous membranes of the nose and mouth. Interstitial traumatic hæmorrhages in the skin and subcutaneous connective tissue, in the parts exposed to pressure, are early symptoms. Joint affections and neuralgia are common.

Treatment.—Of course avoid an operation in a person known to be the subject of this diathesis. The internal remedies most to be relied on are, acetate of lead, ergot or ergotine, hazeline, oil of turpentine, tr. ferr. perchlor., and gallic acid, and with these opium should be combined. In traumatic external hæmorrhage, pressure and liq. ferri perchlor., used

as a styptic. Sometimes the actual cautery is necessary.

Periarteritis often occurs subsequently to thrombosis. The most common causes, independently of thrombi, are traumatic injuries, as bruising, laceration, division, or ligature of an artery, or inflammation in neighbouring tissues, and syphilis. The changes mainly affect the sheath and external coat, which become hyperæmic, pulpy and vascular, and infiltrated with small cells. The middle coat next is the seat of a similar infiltration. Owing to these changes in the external coats, the internal layer is deprived of its vitality, producing coagulation of the contained blood (*vide* Thrombosis).

Atheroma is the result of chronic endarteritis. It is most frequently met with in the arch of the aorta, iliac, tibial, cerebral, coronary, brachial, radial, and ulnar arteries, and especially affects curved parts of an artery, parts in the vicinity of lateral branches, and parts in contact with bones. The fibrous and elastic layers of the internal coat become infiltrated with new cells—some derived from emigrant leucocytes, and others from proliferation of the cells of the tissues—and are thickened (sclerosis). These cells produce a bulging of the innermost layer of the intima. In the initiatory stages this swelling is of a soft consistence and is covered by the lining membrane, on removing which the diseased part comes into view. If the change advance the new cells invade the middle coat, and spread to the external, thus all the coats are weakened and softened so that they are inadequate to resist the pressure of the blood stream, and dilatation, aneurism, or rupture may ensue. When the disease is more chronic the new cells are converted into

oil globules, and the intercellular substance softens, forming a pulpy yellowish mass, external to the lining membrane (atheromatous abscess). If the lining membrane yield, the pulpy debris is swept away, and an "atheromatous ulcer" results. Now and then the fluid part of the degenerated tissue is absorbed, leaving crystals of cholesterin, fatty globules, and a pulpy debris of broken-down tissue in the more external layers of the intima, which may undergo calcareous degeneration. In other cases the new cells are converted into a fibrillated tissue (fibroid thickening). Holmes considers strain or over-stretching of the arterial walls the exciting cause of this affection. Gout, rheumatism, syphilis, alcohol, and chronic Bright's disease, will produce this disease.

Fatty Degeneration differs from atheroma in its not being preceded by any cell proliferation. The change usually begins in the endothelium, and extends from within outwards; the fat globules filling the endothelial cells and forming minute yellowish white patches which are quite superficial, unlike atheroma. These patches ultimately break down, the intercellular substance softens, and the fat being carried away by the blood current, small superficial erosions are produced. In most cases fatty degeneration of an artery is a senile change, resulting from the degradation and lessened vitality of tissue which is a concomitant of advanced years.

Calcification is either primary or secondary (following atheroma). Primary calcification is a senile change, and its most general seat is the muscular coat. The neighbourhood of the nucleus is the place where the calcareous granules first present themselves, and these gradually increase, filling the fibre. Ultimately, the middle coat may be changed into a pipe of calcareous matter (tubular calcification), or the alteration may be more limited, forming isolated rings (annular), or plates (laminar calcification). The calcification spreads from the middle to the external and internal coats. The process is common in the external iliacs and vessels of the lower limb, frequently producing gangrene.

Aneurism.—An aneurism is a tumour formed by a dilatation of the whole or a portion of the coats of an artery, or by its rupture, containing blood, and com-

municating with the trunk of the vessel. It is in most cases single, but occasionally several are met with on the same individual.

Causes.—1. Atheromatous or calcareous deposits in the coats of the vessel, causing them to become weak, and liable to rupture. 2. The middle period of life from thirty to forty. 3. Increased blood pressure from violent and intermittent exertions. 4. Syphilis. 5. Weakness, produced by the artery being situated near a movable joint. 6. External injuries, as blows, violent strains and wounds of an artery.

Varieties.—(a) Spontaneous and traumatic, in accordance with their appearance, with or without visible injury. (b) 1. True. 2. False. True aneurism is when one or more of the arterial coats remain intact. False aneurism is where the vessel is completely ruptured, and the sac is formed by the surrounding connective tissue. Again, true aneurisms are divided into: 1. Fusiform; 2. Sacculated; 3. Dissecting.

1. *Fusiform, or Tubular Aneurism*, consists of a dilatation of an artery, all the coats of which are equally expanded round the circumference of the vessel. In most cases the length exceeds the diameter of the aneurism. It chiefly occurs in the aorta and the arteries of the brain, which are comparatively ill-supported by the surrounding tissues, and is prone to occasion the sacculated form. The external coat is thickened, the middle rigid and inelastic, and the inner atheromatous. The dilatation terminates gradually above and below, but in addition to being dilated the vessel is also elongated. These aneurisms are as a rule very chronic in their course, and, unless a sacculated one be super-added, rarely rupture.

2. *Sacculated.*—In this kind the tumour forms a distinct bag or sac, communicating by a narrow mouth with the side of an artery; it is due to partial dilatation of the arterial coats. The internal and middle coats are usually ruptured, the sac being composed of an expansion and hypertrophy of the external coat, thickened by the sheath and neighbouring cellular tissue. This is by far the most common sort of aneurism, and affects all the great trunks of the body, especially where large branches are given off, or where the artery is exposed

to sudden variations of tension and relaxation. The size of the sac ranges from a pea to that of a foetal head. The shape is spherical, oblong, or pyriform. The aperture of communication, though usually narrow, may be broad and extended.

3. *Dissecting*.—This is produced by the internal coat giving way, and a portion of the middle coat, without any attempt at repair, together with softening and lack of cohesion between the coats. The blood finds its way into the accidental opening, and insinuates itself between the layers of the weakened middle tunic for some inches; then it may either burst through the external, force a passage through the internal, or become chronic, a sac being established in the substance of the middle coat. Dissecting aneurism attacks the aorta and its chief branches, and is most common in women.

False Aneurisms are produced in two ways: 1. By the sudden and immediate production of an opening through all the coats of a vessel, as the result of violence or ulcerative absorption; 2. By the sac of a true aneurism rupturing.

Structure of an Aneurism.—In some cases all the coats of the vessel, though diseased, may be entire, but more usually the inner and middle have disappeared, ceasing on the edge of the communicating aperture, whilst the external coat is greatly thickened and hypertrophied. As a rare event cases are met with in which the sac walls are composed of the inner coat alone. The blood passing into the sac being removed from the full force of the circulatory current, and being exposed to an unhealthy surface, coagulates little by little, forming a succession of concentric laminæ; the outer layers are made up of pale yellowish fibrin, the inner ones are darker, softer, and more coloured, whilst on the centre the blood is liquid. This is termed an active clot. Occasionally the blood coagulates quickly, producing a dark red, soft clot without lamination; the so-called passive clot.

Pressure Effects on Adjacent Structures.

—The sac becomes united to and causes inflammation of the neighbouring tissues, which undergo absorption from atrophy, softening, and deprivation of blood. The symptoms produced by compres-

sion of the parts in juxtaposition with an aneurism are important, especially for the aid they give in diagnosis. As the tumour increases, by pressure on the veins it gives rise to œdema and a varicose state of the subcutaneous venules; on the arteries it may occasion perforation or obliteration; on the nerves it causes pain or disordered function as it expands or stretches them; on the bones, the pressure results in absorption, the aneurism scooping out a hollow for itself, and even perforating the osseous structure. The function of contiguous glands is impaired.

Symptoms of External Aneurism.—1. A *pulsating* tumour, round or oval, distinctly circumscribed, and situated on the course of some known artery. The pulsation is expansile, synchronous with the beats of the heart, and can be felt by placing a finger on each side as well as on the surface. 2. The pulsation disappears on compressing the artery on the proximal side of the tumour. 3. A *peculiar thrill* or rasping sensation is perceived on applying the hand over the aneurism. 4. The tumour is at first soft, later on hard from the coagulation of its contents. It is in its initial stage small, and gradually increases, the enlargement being “seldom so rapid as the outward bulging of an abscess, and seldom so tardy as the enlargement of any tumour not malignant.” 5. It is fixed and does not move up and down on flexing the limb. 6. By compression the size of the aneurism is decreased, but it regains its volume on removing the pressure. 7. A bellows sound (*bruit de soufflet*) is heard with the stethoscope, and is communicated along the line of the artery; this is loudest in pitch when the opening is small. 8. Pulsation is weaker in the artery, or its branches beyond the aneurism, than in those of the healthy side. There are also swelling of the limb below, pain, and difficulty of motion.

Conditions which modify or obscure the pulsation and auscultation signs.—

Pulsation may be wanting when the mouth of the sac is very small, when the aneurism is filled with active or passive clot, and in cases of rupture of the tumour. Inflammatory infiltration between the skin and the sac will modify pulsation. The auscultation sounds generally follow the pulsation.

Diagnosis.—The points which must be considered are firstly the presence of a tumour, secondly its possessing the characteristics of an aneurism.

Pulsating Tumours are most apt to be mistaken for an aneurism. These tumours are erectile in structure and exhibit pulsation, bruit, and diminution on compression; but, as a rule, are not so well defined, more spongy, the bruit is not so marked nor communicated along the line of the artery, take longer to refill on pressure, and the expansile pulsation is not nearly so distinct, being more diffused. These tumours also frequently occur where there is no large artery which could be the seat of an aneurism.

Malignant Growths may possess a distinct pulsation, from their rich supply of vessels, and have been confounded with an aneurism. These growths, however, will frequently occupy a situation which does not correspond with the line of any artery, are irregular, and not distinctly circumscribed, grow rapidly, are hard at first and then soft, without such a marked pulsation as an aneurism, and only have a soft bruit. The pulsation is not diminished in the artery on the distal side of the growth, and the skin and glands are often affected.

Fluid Tumours placed over an artery, from which they receive pulsation, are less liable to be mistaken for an aneurism, as the pulsation cannot be distinguished when the tumour is embraced laterally, the contents cannot be diminished on pressure, and the vessel can be pushed on one side without removing the tumour.

Solid Tumours are diagnosed in the same manner.

Abscesses may be confused with aneurism, or vice versa, especially when the aneurism is diffuse. The history of the case must be considered, and the abscess carefully examined. The difficulties are often very great, for in some instances the aneurism suppurates, simulating an abscess; or again, the aneurism may burst into an abscess cavity; or an abscess, as it tends to the surface, may open a vessel, suddenly increasing its bulk; or finally, an aneurism and abscess may exist together, the latter being formed in the tissues external to the former.

Terminations.—1. The contents may

coagulate, from the deposit of active or passive clot, until all the sac is filled; the clot contracts and is absorbed, with or without the obliteration of the vessel.

2. The artery becomes obstructed, or the mouth of the sac, from thrombosis, or embolism, or the effusion of lymph, or the pressure of the aneurism itself on the trunk of the artery above it. This may be followed by the cure of the tumour, with the obliteration of the vessel, but without inflammation of the sac; but often suppuration and ulceration of the walls of the tumour allow the contents to escape, but, the vessel being closed, no hæmorrhage ensues. 3. The sac opens by suppuration into the surrounding tissues, into a cavity or canal, or externally, without previous obstruction of the vessel. In the two first cases a spontaneous cure results, in the third, a fatal hæmorrhage.

Treatment.—General. To reduce the quantity of blood and the force and frequency of the heart's action, entire rest and quietness, the patient being kept in bed, and not allowed to rise for any purpose. Spare diet, consisting chiefly of bread with a little meat, as small a quantity of liquids as possible, and no stimulants. Barwell recommends the following dietary.—Low diet: Bread 10ozs., butter 1oz.; rice or tapioca pudding, 6ozs.; milk, 1 pint, divided into three or four meals, or—Dry diet: For breakfast and supper, bread 4ozs., butter $\frac{1}{2}$ oz., milk 2ozs.; for dinner, meat 3ozs., bread 3ozs., water or milk 3ozs. Drastic purgatives should be given two or three times a week, and iodide of potassium in large doses, gr. xx t. d. s., combined with ammonia. Belladonna, digitalis, hydrocyanic acid dil., tr. of aconite and ergot, are useful in the order set down, and bromide of potassium for laryngeal symptoms. If the patient be old or anæmic, ferruginous preparations, a dry, nourishing meat diet, and the constant administration of opiates.—Local. 1. *Compression* is always to be tried, if possible, on the artery between the sac and the heart, except when the return of blood is not free, or the aneurism is rapidly increasing and likely to burst. The means by which pressure is applied are: 1. The fingers (digital). The thumb of one hand is placed on the vessel, and the thumb of the other pressed over the digit to support it; the fingers soon

become fatigued, and this is best avoided by a weight or bag of shot resting on the fingers. A relay of assistants is necessary, as one person cannot effectually compress a large artery for more than ten minutes at a time; 2. Instrumental. For this purpose the tourniquet (Cartes', etc.), or a weight ($7\frac{1}{2}$ lbs.), or Esmarch's bandage and tourniquet; if necessary, an anæsthetic must be administered, and the narcotism kept up for hours. Compression may be "gradual" or "rapid." The gradual may also be continuously applied or at intervals. The pressure in the gradual method is not intended to stop the flow of the blood completely, but to induce the formation of a laminated clot by retarding the rate of the blood stream. The chief difficulties are pain and irksomeness, which must be mitigated by powdering and shaving the part, and placing wash leather over the skin. The pressure should be very mild to commence with, the place of application changed frequently, and the patient afforded intervals of complete rest. Hypodermic injections of morphia are soothing. In the rapid mode of procedure the circulation is completely stopped, and a passive clot is formed. Duration of compression is from a few hours to days.

Reid's Method.—In this plan of treatment Esmarch's bandage is used. The pressure over the sac should be slight, or perhaps the sac may be avoided altogether, by bandaging as lightly as possible over the tumour, or even skipping it by one or two adroit turns of the roller, and leaving its surface free. An anæsthetic must always be given, and the apparatus retained in position for from one to two hours. As the clot which forms is not very firm, a tourniquet should be employed for some hours after Esmarch's appliance is removed. This mode is best fitted for small aneurisms, and Holmes recommends it where digital and instrumental compression have failed. The dangers are rupture of the sac and gangrene, so it should not be used where the tumour is large or inflamed.

2. *Flexion, i.e.*, bandaging the limb in the flexed position, in small aneurisms of the leg and arm. This may be conjoined with other ways of treatment.

3. *Ligature.*—The materials used are carbolised silk, ox aorta, prepared cat-

gut or kangaroo tendon. The best ligature is the middle coat of ox aorta as introduced by Barwell; he advises its preparation as follows: "Procure from a butcher the aorta of an ox (not split up as is usual, but entire); see that it comes straight from the slaughter-house and has not been kept; if it can be made into ligatures at once it is better; if not, place it till opportunity offers in a 3 per cent. solution of carbolic acid. Strip off the outer coat. The middle and inner coats are then to be cut with a pair of scissors spirally round and round, so as to make the whole into a tape-like cord." It is then suspended and a weight of from $\frac{1}{4}$ to 2 lbs. hung to it, such as will stretch it half its own length. This is done in an atmosphere warm enough and dry enough to desiccate the ribbon in about five hours. After which, any irregularities are trimmed off with a pen-knife. The material as it dries becomes transparent and horny, like vellum; it will keep any length of time rolled up in a coil, but must not be sharply bent when dry. I store it in antiseptic gauze under a glass case. About seventy minutes before use, it is to be steeped in a 3 per cent. solution of carbolic acid, when it becomes perfectly flexible. For passing it an aneurism needle is required whose eye is slit a little longer than usual. This ligature becomes organised, and part of the body into which it is inserted. There are three situations in which a ligature may be applied: (a) Old operation or Antyllus' method. Here the sac is laid open and the contents removed, ligatures being applied above and below the sac; it is only used for traumatic aneurisms where the artery is healthy; (b) Hunter's method. The ligature is affixed on the cardiac side *at a distance* from the sac, this site being invariably selected, if possible, in the present day.

Conditions indicating Hunterian ligature (Holmes).—1. When the aneurism (advancing or threatening to advance) is situated on an artery inaccessible to pressure, but which will allow a ligature to be put round it without excessive danger, and with a sufficient space between the part tied and the tumour. 2. When, in an aneurism differently situated, the patient, from nervous irritability, drunkenness, or any other

cause, is intolerant of more gradual methods. 3. When these methods have been tried and failed. 4. When an aneurism has burst into one of the internal cavities of the body, *e.g.*, a popliteal aneurism into the knee-joint. 5. When the rupture has taken place subcutaneously, amputation or the ligature is generally indicated, still, in some less grave cases, it may be possible to obtain a cure by compression, but the attempt should not be too long persisted in; while, if the symptoms are urgent, or if gangrene have commenced, amputation is the only resource.

Contra-Indications.—The ligature is not to be applied if compression can be used; nor in recent traumatic aneurism without a previous trial of rest, position, careful bandaging, and pressure, direct or indirect; nor if the heart or the great part of the arterial system is diseased. After the main artery is tied the pulsation and bruit cease, and the anastomatic channels of the branches which arise above and below the impervious part afford a new course for the conveyance of blood. The limb is at first cold and numb, but it rises in temperature after a few hours, and is red and painful. The blood, finding its way by the collateral circulation into the aneurism forms the fibrinous layers which occlude the sac. The tumour gradually diminishes in size by the action of the absorbents, and is finally converted into a fibrous mass. The artery is obliterated at the seat of deligation, and at the neck of the sac, between these two points it is pervious, so that two arches of anastomoses are necessarily developed, one carrying the blood past the seat of ligature, and the other past the neck of the sac. If no large branch occurs between the place where the vessel is tied and the sac, the artery is completely effaced between these points, and only one anastomatic arch formed.

(c) *Distal Ligature* is used where it is impossible to tie the artery on the cardiac side; but as the aneurism is left exposed to the whole force of the blood stream, it is not a very successful method. The intention is to procure divergence of the blood current through the collateral circulation. The operation is termed Brashdor's, or Wardrop's. Wardrop pointed out that this plan was best

fitted to arteries (as carotid) where no branch intervenes between the aneurism and the ligature; he also suggested and performed a modification of distal ligature, consisting in tying one of the two terminal branches of the artery on the distal side of the sac.

Unfavourable Results, which may follow ligature: (a) Secondary hæmorrhage, generally from the fourteenth to the twenty-first day. (b) Continuance or return of pulsation in the sac from the presence of a vas aberrans or undue activity of a collateral circulation; at a later period, after persistence of apparent cure, or within a month, from defective formation of the clot. (c) Gangrene of the limb. (d) Suppuration of the sac.

4. *Distal Pressure* on the main artery.

5. *Temporary Occlusion* of the chief artery by æcupressure, or Dix's wire compress. The artery is cut down on, and an aneurism needle passed. A piece of wire nine inches long is threaded through the needle and carried under the artery. A straight needle is attached to each end of the wire and passed through the tissues and skin on one side of the wound. The needles are removed and the ends of the wire twisted over a cork, which acts as a compress over the artery.

6. *Manipulation*, by handling the tumour, so as to detach the clot and obstruct the distal end of the artery, or induce further coagulation.

7. *Galvano-puncture* (*vide* Aortic Aneurism). 8. *Injection of perchloride of iron into the sac*, the artery being compressed above and below the tumour.

9. *Introduction of wire* or horse-hair into the sac through a canula. 10.

Injection of ergotin in parts surrounding the sac. 11. *Amputation* in some cases is the only resource: (a) When the tumour

has implicated a bone or joint. (b) If the vessel be too diseased to admit of ligature. (c) When aneurism is diffused and gangrene appears to be supervening, or has supervened. (d) If a diffused aneurism has been incised by mistake for an abscess.

Aneurism by Anastomoses, Cirroid Aneurism, or Racemose Aneurism, is often congenital, but may arise from traumatic injury, and is most frequently met with about the scalp, orbit, lips, or face, and occasionally in the palm of the hand. It consists of a dilatation of a number of small

adjacent arteries, or a single vessel with its branches. If small arterial branches or capillaries be enlarged, the term aneurism by anastomoses, or racemose aneurism, is applied; if larger vessels, cirroid aneurism. The arteries become elongated, tortuous, and wider than normal, their coats being thinned; the convolutions thus formed are united by a small amount of connective tissue. The structures in contact with the diseased vessels undergo atrophy, and the subjacent bones are often deeply grooved, or even perforated. The tumour may progress rapidly or remain stationary; at the time of puberty, or in pregnancy, it often advances rapidly, and in the latter case, hæmorrhage is apt to occur.

Symptoms.—Aneurism by anastomoses is always seated, under the skin or mucous membrane, in the connective tissue. Here it forms a tumour, covered by the integument, which may be thickened, of a natural appearance, or thin and transparent, allowing the colour of the blood to be seen. The swelling pulsates synchronously with the heart's beat, is not distinctly circumscribed, being ill-defined at its margin, becomes smaller when compressed, has a spongy feel, and is fed by large tortuous vessels. It has a well-marked bruit and thrill, particularly over the centre of the growth. At birth it is usually small, but enlarges at puberty.

Causes are uncertain. Virchow considers it a vascular neoplasm. Billroth opines that the resistance of the arterial walls is diminished by subacute inflammation; others by fatty degeneration. Traumatic injury is a common forerunner.

Treatment.—If small, the injection of styptics, galvano-cautery, ligature *en masse*, or excision, are to be used; taking care in the latter plan to cut widely from the disease on account of the hæmorrhage. If large, removal by ligature or excision, preceded by deligation or acupressure of all the branches supplying the tumour. Tying all the nutrient vessels of the growth, combined with incisions round its circumference between these, and followed by compression in the line of the incision, or the use of setons; should there be much hæmorrhage divide the operation into several sittings at intervals. Ligature of the main vessel is sometimes necessary. Holmes, in cirroid

aneurism of the scalp, recommends ligature of both carotids.

Angeioma or Nævus.—1. Capillary. 2. Venous. Capillary nævus, or telangiectasis, is met with on the face, head, neck, arms, and trunk, but rarely on the lower extremity. It is always congenital, being at first small but increasing rapidly after birth.

Symptoms.—The nævus appears as a bright red or purplish spot of variable size or shape, flat on the surface but perceptibly raised above the level of the surrounding skin. It sometimes tends to stop growing spontaneously, and degenerates, but is also liable to inflammation and ulceration with hæmorrhage. It is produced by an excessive development of the capillaries of a part.

Venous Nævus is an enlargement of the venous radicles, of an area, which become dilated into small sinuses with thin walls. It is generally developed in the subcutaneous or submucous connective tissue, and may be conjoined with a capillary nævus.

Symptoms.—The skin is thin and transparent, and through it a bluish patch may be detected of a dark, purplish colour. It may be considerably elevated, even forming a distinct ovoid or lobulated tumour; in other cases the skin is thickened and only a fulness is apparent. There is no pulsation, but the growth has a soft, boggy, or doughy feel; enlarges on coughing or crying, and decreases on compression, slowly refilling. It may take on a fatty change (nævroid lipoma), or undergo cystic degeneration. It is often deep-seated, and not uncommonly situated on the lower extremities.

Treatment.—By any mode of treatment a scar is left equal to the extent of area of the nævus. If small and cutaneous, vaccination, ligature, setons, caustics, as nitric acid, and nitrate of mercury, potassa fusa, chloride of zinc, ethylate of sodium, Vienna paste, hot iron, Paquelin's thermo-cautery, gas cautery, or galvanic cautery. If subcutaneous, excision by removing the skin and excising without opening capsule. Teale has pointed out that the skin should be preserved, even when discoloured, as it generally assumes a natural colour. Subcutaneous ligature. Breaking up the contents with a tenotome combined with pressure. Subcutaneous injection of perchloride of iron, tannic acid, or chloride of zinc. Setons

steeped in perchloride of iron. Electrolysis. Ignipuncture (the tumour being pierced by a needle which is then heated). Squire removes port wine birth marks by freezing them with the ether spray, and making a number of fine parallel incisions from $\frac{1}{32}$ to $\frac{1}{16}$ of an inch apart,

and $\frac{1}{16}$ of an inch in depth. A piece of blotting paper is laid on the incision and gently pressed down for five minutes. In half an hour it is removed, after being wetted with cold water, and the blood clot washed off with a brush.

CHAPTER XX.

ANEURISMS OF SPECIAL VESSELS, AND THEIR TREATMENT.

Aortic Aneurism.—Aneurisms are frequent along the course of the thoracic aorta, and are met with either *within* or *without* the pericardium. Aneurism of the arch of the aorta generally terminates by exhaustion, irritation or disease of the heart, brain, lungs, or kidneys; when the descending aorta is the part affected the issue is, as a rule, rupture.

Symptoms.—Bruit de soufflet, enlarged area over which the second beat of the heart is audible, and dulness on percussion. Local bulging may or may not be present, its site depending on the portion of the aorta involved; when the ascending or transverse portion is affected, a tumour is produced in front on the right side of the chest, three or four inches below the clavicle, and occasionally projecting above the sternum; whilst aneurism of the descending aorta forms a swelling on one side of the spine or under the scapula. *Pulsation* will be present in the bulging.

Pressure effects.—Pain is occasioned of a lancinating character from pressure on the spinal and sympathetic nerves; and later on of a boring, burning, or gnawing character, owing to perforation of the contiguous bones. Difficulty of breathing and cough arise from compression of the trachea, bronchi, lung, pneumogastric and recurrent laryngeal nerves, or lastly from pressure on the pulmonary vein. The dyspnoea increases on bodily exertion, as walking up hill; during the later stages the patient may be unable to lie down (orthopnoea). Difficulty in swallowing, accompanied by pain and a sensation as if the body were tightly bound with a cord, from pressure on the intercostal nerves. Gastric troubles.

Loss of voice (aphonia) is sometimes met with in advanced cases from laryngeal congestion, the result of pressure on the veins, or paralysis of the vocal cord from compression of the recurrent laryngeal nerve. Inequality of the radial and carotid pulses, irregularity of the pupils from pressure on the sympathetic nerve. Displacement of the heart downwards and to the left. Oedema of the upper extremities and the head. If the compression extend to the azygos veins a dilated condition of the venous branches on the front of the chest will be apparent.

Duration of the disease is from a few months to three years, but the average time is from nine to twelve months.

Treatment.—Constitutional should always be tried. Other methods which have been used are: 1. Injection of perchloride of iron into the sac. 2. External manipulation. 3. Galvanopuncture. This is serviceable if the aneurism have not advanced too far and have a distinct bruit; when the sac presses on but has not perforated the parietes the condition is favourable to this plan. The patient should rest in bed and have a hypodermic injection of morphia. Two fine steel needles with sharp points, insulated with vulcanite or gun elastic to within half an inch of the points, are introduced into the sac, care being taken that they are not in contact. The battery employed must be a constant one with a large number of cells and low electro-motive power; five cells are generally sufficient. The current may be continued for an hour. The punctures are at once sealed with lint and collodion. If necessary the operation may be repeated at intervals of a week.

4. Inserting fine iron wire through a canula, or, better, using fine darning needles in pairs crossing one another in the sac. 5. Simultaneous or consecutive ligature of the right carotid and third part of the subclavian artery. 6. Ligature of the left carotid. These latter modes are all dangerous and should be avoided, with the exception of galvano-puncture and deligation.

Barwell gives the symptoms concerning the ligature of arteries as follows :

1. For deligation of the left carotid. Tumour symptoms upon and somewhat, but not far, to the left of the middle line, and rising into the episternal notch or beneath the left mastoid. Left venous congestion ; alteration of the left carotid, and to a greater degree of the left radial pulse. Paralysis of the left vocal cord ; obstruction to the entrance of air equal on both sides of the chest ; sometimes alteration of the left pupil.

2. For deligation of the right carotid and subclavian. Tumour symptoms on the right of the median line ; marked changes in the right radial and carotid pulse. Venous congestion on the right side, affecting first and chiefly head and neck, afterwards, with increase of tumour, right arm and chest, and the right vocal cord may be paralysed. Tumour symptoms on the right of and upon mesial line, running up to the sterno-clavicular joint and episternal notch ; venous congestion on the left side, alteration of the right pulse (radial and carotid) ; tracheal dyspnœa. Tumour further to the right and lower (second space) ; congestion equal on both sides ; no marked difference between the two pulses ; heart displacement chiefly outwards. Pressure on the right bronchus ; left lung perfectly free ; with puerile respiration and perhaps emphysema. With any of these conditions changes of the right pupil may be combined.

3. Doubtful signs, only to be read by light of other symptoms. Venous congestion on the left side, tracheal dyspnœa, dysphagia.

4. Operation should be avoided : When the tumour symptoms reach widely on both sides of the mesial line. When, with paralysis of the left vocal cord, there is obstruction of the right bronchus. When "locomotive" pulse, thrill, and double murmur show considerable aortic incompetence. When there is mitral disease or

considerable cardiac hypertrophy. When there is in the course of the aorta the rasping sound of calcification or advanced atheroma, more particularly if the superficial vessels be felt to be rough and rigid. When there is pain about the spine and intercostal nerves ; when there is obstruction of the left bronchus only ; when there is pressure on the left apex and expectoration of frothy blood, and when the symptoms are so indefinite as to render any diagnosis as to the site of aneurism doubtful.

If there be severe laryngeal symptoms depending on pressure on the laryngeal nerve, laryngotomy is justifiable, or blood letting, or injection hypodermically of sulphate of atropine.

Aneurism of the Innominate. — The symptoms are similar to those of aortic aneurism, with which this has often been confounded. 1. Bruit de soufflet diminishing downwards, and ascending the arteries on the right side but not on the left. This may be absent, but the heart's sounds are very marked over the tumour, and the second sound is often louder than the first. 2. Presence of a pulsatory tumour or bulging, behind the right sterno-clavicular articulation and episternal notch, rising into the neck, and accompanied by dulness on percussion over the upper third of the sternum, the inner half of the clavicle and infra-clavicular region. 3. Pressure effects. Pain of a neuralgic character radiating along the right side of the neck, head, chest, shoulder, and arm, from pressure on the cervical and brachial plexuses. Dyspnœa from compression of the recurrent laryngeal nerve. Dysphagia from encroachment on the œsophagus. Contraction of the right pupil from pressure on the sympathetic. The pulse is much weakened in the right radial and right carotid arteries. Enlargement of the external jugular and subcutaneous veins of the right side of the chest, followed by œdema, showing that the jugular, subclavian, and brachio-cephalic veins are interfered with. Occasionally dislocation of the sterno-clavicular joint.

Diagnosis must be determined by the facts that the signs correspond to the position of the innominate. The tumour makes its appearance early, all the pressure symptoms are confined to the right side, and by controlling the circulation in the carotid and subclavian

on the same side the pulsation is diminished.

To distinguish this from aortic, Agnew gives the following table :—

INNOMINATE.	ARCH OF THE AORTA.
<ol style="list-style-type: none"> 1. Presence of a tumour which can generally be felt and seen at the right sterno-clavicular articulation. 2. Pain over the anterior part of the chest, on the right side of the head, neck, and face, and down the arm and chest of the right side. 3. Pain generally acute and neuralgic, rarely dull, gnawing or boring in character. 4. Venous congestion and œdema commence over the right side of the neck and arm. 5. Dyspnœa and cough common, but not usually intense. 6. Left lateral deflection of the trachea and of the œsophagus. 7. Numbness and loss of power in the right arm. 8. Pulsation in right radial weak. 9. Stridor occasional. 10. Murmurs propagated from the sac in the direction of the subclavian and carotid arteries. Double heart sounds very common. 	<ol style="list-style-type: none"> 1. The presence of an external tumour exceptional. 2. Pain deeply situated ; often between the shoulders, or under the sternum, and frequently encircling the upper part of the chest. 3. Pain frequently gnawing and boring. 4. Venous congestion and œdema more common over the chest. 5. Dyspnœa and cough as the disease advances, often very severe and persistent. 6. No lateral deflection. 7. These symptoms uncommon. 8. Pulsation in both radials weak, but more so in the left than the right. 9. Stridor common. 10. When present, confined to the region of the sac, and may be on the left side and downwards. Double heart sounds not common.

Prognosis is exceedingly unfavourable, the patient generally succumbing to asphyxia from pressure on the recurrent laryngeal nerve or trachea.

Treatment.—Constitutional, on the principles before mentioned, must be carefully tried. Other methods which have been employed are : 1. Ligature of the subclavian ; 2. Ligature of the carotid ; both of which are worse than useless ; 3. Simultaneous ligature of the carotid and subclavian—if operative measures are considered necessary, this last operation is the only one worthy of trial ; 4. Galvano-puncture.

Aneurism of the Carotid occurs most commonly in men, but the proportion of women affected is much higher than in other aneurisms. It is occasionally met with at an early age. The right carotid is most usually involved at the seat of bifurcation, but it may occur just above the clavicle, at the lower part of the neck.

Symptoms are those common to all external aneurisms. *Pressure effects.*—These are dyspnœa, from its compressing the œsophagus, larynx, and pharynx. Irritation of the larynx, with troublesome hacking cough, from pressure on

the superior laryngeal nerve ; spasms of the larynx, from squeezing of the inferior laryngeal nerve. Shooting pains in the head. Cerebral symptoms, owing to diminished circulation, as vertigo, dimness of vision, tinnitus, and a tendency to coma. The subcutaneous veins are generally enlarged and conspicuous, and the neck stiff and almost immovable. The tumour enlarges chiefly in the direction of the middle line.

Diagnosis.—From varix of the internal jugular vein this disease is distinguished by the varix being soft, not pulsating eccentrically, diminishing in size on a full inspiration or on compression on the *distal* side, increasing in size during expiration and when pressure is applied to the proximal side. From *glandular tumours* by the history, by pressing the tumour away from the subjacent artery, absence of bruit, thrill, or *expansile* pulsation, and by the nodulated, irregular swelling caused by the glandular mass. In addition, pressure on the carotid does not diminish a glandular swelling. From *abscess* by this presenting fluctuation, absence of eccentric pulsation and distinct bruit, inability to diminish the contents on pressure, and signs of inflam-

mation. From *solid tumours* (*vide* Aneurism). From *cysts*.—These are distinguished from a carotid aneurism by the facts that they are not affected by pressure, do not pulsate, have no bruit, and fluctuation can be readily detected. From *pulsating bronchocele*.—1. By the isthmus of the thyroid and opposite lobe being implicated as well as the one lobe. 2. By the thyroid moving up and down on directing the patient to swallow. 3. The bronchocele is most firmly attached in the middle line, an aneurism under the sterno-mastoid. To distinguish carotid aneurism from aneurism of the aorta or innominate, a careful consideration must be made of the symptoms and physical signs. Gross writes: "The most reliable sign with which I am acquainted is afforded by our ability to insinuate the point of the forefinger between the top of the sternum and the lower extremity of the aneurism while the head is being bent powerfully forwards to relax the mastoids. If this can be done, the probability is the tumour is connected with the carotid."

Course and Terminations.—Carotid aneurism usually runs its course in from twelve to eighteen months, if untreated, the patient dying from the pressure effects, gangrene of sac, ulceration into the trachea, bronchi, or chest, with internal bleeding. Embolism of the cerebral vessels.

Treatment.—1. Try the usual constitutional treatment. 2. Digital compression, the artery, if possible, being seized on the proximal side of the sac, between the thumb and fingers, under the borders of the sterno-mastoid, and bilateral pressure applied. 3. Ligature of the carotid on the proximal side. 4. Ligature on the distal side when aneurism is placed at the root of the neck.

Instruments required for deligation of arteries: 1. One or two scalpels; 2. Two forceps; 3. Grooved director; 4. Eyed probe; 5. Retractors; 6. Tenaculum; 7. Various forms of aneurismal needles; 8. Ox aorta, prepared catgut, silk or other ligatures; 9. Tourniquet; 10. Sutures; 11. Lint or absorbent cotton, or aseptic dressing (*vide* wounds); 12. Bandages; 13. Anæsthetic and inhaler; 14. Artery and torsion forceps, and acupressure needles; 15. Sponges on sticks; 16. Large sponges; 17. Drainage tubes.

General Directions for ligaturing an

artery.—1. Ascertain the line of the vessel, and if possible feel its pulsations. 2. Expose one by one the muscles or other structures used as guides to the position of the artery; for instance, in deligating the carotid the sterno-mastoid is to be exposed, and then the omo-hyoid muscle—until these are recognised in order no attempt should be made to search for the vessel. 3. Arrangement of tissues from without inwards is: (a) skin; (b) superficial fascia, consisting of adipose and connective tissues; (c) deep fascia; (d) muscular structures. The first three tissues are divided separately, the superficial and deep fasciæ being raised on a director before being incised. 4. After division of the deep fascia avoid using the blade of the knife, and employ the forceps or handle of the knife to expose the sheath of the artery. 5. To open the sheath a fold is pinched up and divided with the knife held so that the cutting edge is directed away from the artery, and then incised on a director for a sufficient extent, but the sheath is not to be more disturbed than is requisite to pass the ligature round the artery.

Ligature of the Carotid.—The point of selection is just above the omo-hyoid muscle. The *course* of the artery is that of a line drawn from the sterno-clavicular joint to a point midway between the mastoid process and the angle of the jaw.—(1st Step.) The incision.—With the head held back, and the face turned to the opposite side, an incision is made $2\frac{1}{2}$ to 3 inches in length over the anterior border of the sterno-mastoid, with its central point opposite the cricoid cartilage; this divides the skin, superficial fascia, and the platysma. (2nd Step.) Exposure of sterno-mastoid.—The deep fascia is carefully divided to the full extent of the superficial incision on a director, and the fibres of the sterno-mastoid exposed.—(3rd Step.) Exposure of omo-hyoid.—The head of the patient is slightly raised and the edges of the wound held apart, with the sterno-mastoid and the superficial thyroid vein and descendens noni nerve. The tendon of the omo-hyoid is seen crossing the sheath of the vessel, from above downwards and outwards, at the level of the cricoid cartilage. This must be clearly recognised.—(4th Step.) Opening the sheath.—The sheath is cautiously opened on the tracheal side for about half an inch.—(5th Step.) Cleaning the artery.—The distended in

ternal jugular vein is drawn to the outer side, the pneumo-gastric nerve accompanying it, and a small portion of the artery is then carefully separated from its sheath, and the needle passed from without inwards to avoid the vein.

Ligature below the Omo-hyoid.—The steps for ligaturing the vessel in this part of its course are similar to those used for deligation of the subclavian or innominate (*q.v.*). The internal jugular is pressed to the outer side and the needle passed from without inwards. After tying the carotid, when the ligature is tightened all pulsation should cease in the temporal artery of the same side.

Sequelæ of Ligature.—1. Secondary hæmorrhage. 2. Suppuration of the sac. 3. Cerebral complications, arising immediately, or after an interval of some days, weeks, or months; these are convulsions, vertigo, syncope, paralysis, abscess, softening, defective eyesight and hearing. In some cases apoplectic symptoms arise. 4. Lung disease, congestion, and a low form of pneumonia.

Anastomotic Circulation.—The inferior thyroid of the subclavian with the superior thyroid; the vertebral with the internal carotid; the cervicalis ascendans with the muscular and occipital; and the cervicalis profunda with the arteries supplying the deep muscles of the neck, and the princeps cervicis of the occipital. Of the opposite side: superior thyroids, linguals, facials, occipitals, internal maxillaries, and superficial temporals; also terminal branches of vertebrals and internal carotids by the circle of Willis.

Aneurism of the Subclavian is most frequently met with on the right side and in middle life. The third part of the artery is the most common seat on the right side; on the left side it is always in the cervical position.

Symptoms.—1. A tumour with the ordinary aneurismal characters situated at the base of the posterior inferior triangle of the neck, external to the clavicular origin of the sterno-mastoid, and just above the clavicle, but if the shoulder be raised it may sink below this. 2. The pressure effects are numbness of the hand and arm, owing to the brachial plexus being compressed, with severe neuralgic pains running from above the clavicle down the arm and the back of the shoulder. Occasionally spasm of the diaphragm from implication of the

phrenic nerve. The external jugular and subclavian veins are usually distended, and there is œdema of the hand, arm, neck, and face. It may press on the clavicle and rib, producing atrophy and erosion.

Diagnosis.—From enlarged glands. The character of the pulsation, and ability to move glands from underlying artery, are sufficient to distinguish this from aneurism. From carotid aneurism, the difference in radial pulsation will separate it.

Prognosis.—If untreated, the tumour bursts externally or into the pleura or air passages. In a few instances spontaneous cure has occurred.

Treatment.—Constitutional is always to be tried before any other plan. 1. Compression on the proximal side where possible. 2. Direct pressure on the sac by means of a bag of shot. 3. Distal compression, useful conjoined with other methods. 4. Subcutaneous injection of ergotin into tissues adjacent to the sac. 5. Manipulation. 6. Ligature of the brachio-cephalic (this has only been successful in one case, Dr. Smyth's, where the carotid and vertebral were also deligated). 7. Galvano-puncture. 8. Ligature of the subclavian in the third part of its course on the distal side (fairly successful). 9. Ligature of the first part of the subclavian (uniformly fatal). 10. Ligature of both carotid and subclavian just beyond their origins (unsuccessful). 11. Ligature of the subclavian, carotid, and vertebral close to their commencement. 12. Ligature of the carotid, subclavian, and all its branches except the superior intercostal (Sabine). 13. Amputation at the shoulder joint with distal ligature of the artery as high up as possible.

Ligature of the Brachio-Cephalic.—With the patient on his back, shoulders raised on a pillow, over which the head is well thrown back and face turned to the left side, the operator standing on the right side makes an incision $3\frac{1}{2}$ inches long, running along the anterior border of the steno-mastoid, and ending half an inch above the sternum. Another the same length is carried outwards from the lower end of the first half an inch above and parallel with the right clavicle. The incisions must be carried down to the superficial fascia, and the triangular flap carefully dissected up. The

sternal and part of the clavicular attachments of the sterno-mastoid must be divided on the finger or a director half an inch above their origin, and drawn upwards and outwards, uncovering the sterno-hyoid and thyroid, and the middle cervical fascia, which is very thick, and covered by the inferior thyroid veins. Next divide the fibres of the sterno-hyoid and thyroid on a director, draw the thyroid veins aside, and scrape through the fascia very cautiously, exposing the root of the right carotid, which is traced downwards to the innominate, the patient's head being drawn strongly backwards. The internal jugular is carefully pressed outwards with a retractor, and the left innominate vein which crosses the artery in front from left to right must be drawn down. On the right side are the right innominate vein and the pneumo-gastric nerve in close contact, to avoid which the ligature is passed from the outer side. Behind are the apex of the lung and the pleura, which may be injured if the needle be not kept close to the artery. Sédillot makes an incision along the interval between the clavicular and sternal heads of the sterno-mastoid, separates these, flexes the patient's head, raises the sterno-hyoid and thyroid and divides them, and thus obtains access to the vessel. All the cases except one have proved fatal from secondary hæmorrhage, or inflammation of the lungs and pleura.

Anastomotic Circulation.—Aortic intercostal with superior intercostal. Lower intercostals with thoracic branches of internal mammary. Deep epigastric with internal mammary. Also communications across middle line in the neck and brain.

Aneurism of the Axillary Artery occurs most frequently on the right side, and is most common in men.

Symptoms.—If the aneurism affect the artery above the pectoralis minor, a swelling projects immediately below the clavicle; when the vessel is diseased below that muscle it pushes forward the anterior fold of the axilla, and extends downwards and forwards, filling up the axillary space. The shoulder is raised to relieve pain caused by pressure of the tumour on the axillary nerves, and the patient bends the neck to the injured side and supports the corresponding arm.

Pressure Effects.—Pain and numbness

of the hand and arm. Caries of the first two ribs. The pulse may be absent at the wrist, and the arm œdematous from compression of the axillary vein.

Diagnosis.—From abscess, by the history and course of the swelling. From osteo-aneurism of the head of the humerus, by this commencing at a distance from the line of the vessel, being firm, smooth, elastic, and nearly incompressible, and later on the presence of egg-shell crackling.

Terminations.—If untreated the patient will die from rupture of the sac, gangrene of the limb, or constitutional irritation. In a very few cases spontaneous cure has been met with.

The third part of the subclavian is sometimes affected as well as the axillary artery.

Treatment.—1. If possible, compression with the fingers or Cole's compressor. 2. Ligature of the subclavian. Holmes writes: "1. There are a great number of these aneurisms, both traumatic and spontaneous, which are amenable to gradual intermittent pressure carefully applied to the artery above the tumour (and possibly Esmarch's bandage might in some cases be found serviceable). 2. When this is not possible, from the pain produced by the pressure, the application of rapid total compression, under anæsthesia, may produce a cure. 3. The ligature of the subclavian artery is so dangerous, both from its own risks and the proximity of the sac, that it ought to be restricted to cases where pressure has failed, and to those in which, from the size and rapid growth of the axillary tumour, the surgeon thinks pressure unadvisable. 4. The old operation is to be preferred to the ligature of the subclavian in cases of ruptured artery; and it may be practised in cases where, from the elevation of the shoulder, or from the extent of the tumour, the surgeon would find it difficult to tie the subclavian, or fears in doing so to injure the sac; but the anatomical relations of axillary aneurism render this a peculiarly hazardous proceeding, and the surgeon should always be prepared to amputate if necessary. 5. In very large axillary aneurisms if any treatment be adopted the arm should be amputated at the joint after ligature of subclavian."

Ligature of the Subclavian. Third part.—The line extends from behind the sterno-clavicular articulation, as far as the lower border of the first rib, crossing the lower part of the neck in an arched course over the bag of pleura and the first rib. The vein lies at a lower level than the artery, and above it are the cords of the brachial plexus.

Operation.—The patient is placed on his back, with his shoulder depressed as much as possible by an assistant drawing down the arm, the head is thrown back, and the face turned to the opposite side.

(1st Step.) Incision. — The integuments are drawn down from the neck upon the clavicle, and divided directly upon that bone for three or four inches, beginning an inch outside the sterno-clavicular articulation, and severing the skin, superficial fascia, and the platysma. On releasing the tension the elasticity of the skin carries the wound upwards, so that it corresponds to the position of the artery above the clavicle.

—(2nd Step.) Division of the deep fascia. — The sterno-mastoid and trapezius may be divided on a director if necessary. By a little dissection the external jugular vein is exposed and held aside or divided between two ligatures, and with it frequently a plexus of veins; the transversalis colli and humeri veins should also be avoided. The deep fascia is divided on a director.—(3rd Step.) Expose omo-hyoid.—The lower edge of the posterior belly of the omo-hyoid must then be sought for. Draw this muscle upwards and outwards with the supra-scapular artery.—(4th Step.) Recognise scalene tubercle. — Feel for the tubercle of the first rib following down the outer border of the scalenus anticus close to the outer edge of the sterno-mastoid. Upon the rib immediately above and behind the tubercle the artery will be found covered and bound down to the rib by a dense fascia.—(5th Step). Clearing the artery.—The front of the artery is cleared and the sheath opened and the needle passed with the left finger on the scalene tubercle, round the part of the artery resting on the rib, upwards and outwards from the side of the vein, taking care not to include a nerve of the brachial plexus.

Other Methods. — 1. If the above incisions be insufficient a second vertical

cut may be made at right angles to the centre or inner extremity of the first. 2. A single linear perpendicular incision (Roux). 3. A single curved incision above the clavicle, with its concavity upwards, three or four inches long, with its inner end rather higher than the outer (Green and Fergusson). 4. A curved incision, with its convexity outwards and its base on the posterior edge of the sterno-mastoid, from three inches above the clavicle to the clavicular attachment of that muscle (Skey). 5. If more room be wanted, the clavicular attachment of the sterno-mastoid is divided, and the scalenus anticus exposed and divided as far as necessary, care being taken of the phrenic nerve, which lies on the muscle and must be drawn aside. 6. If the clavicle be so elevated as to prevent the exposure of the artery, a portion of it may be excised.

Anastomotic Circulation.—The internal mammary with the external mammary and superior thoracic; by the deep cervical with the arteries of the shoulder; by the transversalis humeri with the acromial thoracic; by the transversalis colli with the subscapular; by the long thoracic with the epigastric; supra-scapular with the dorsal branches of the subscapular; posterior scapular with the costal and muscular branches of the subscapular.

Accidents following Ligature.—1. Inflammation, within the chest, of the lungs, pleura, or pericardium. 2. Suppuration of the sac. 3. Secondary hæmorrhage from the seat of ligature or the sac. 4. Gangrene of the hand and arm.

Treatment of inflamed axillary aneurism threatening suppuration.—Spence recommends cutting down on the third part of the subclavian, so that an assistant can compress this thoroughly, and compressing brachial below also. Then opening the aneurism in the axilla, turning out the clot, and ligaturing the artery above and below the sac. This is the right procedure to adopt; but if the aneurism be small and circumscribed, and the limb warm, and not œdematous, ligature of the third part of the subclavian may be tried. If hæmorrhage occur, or the aneurism have ruptured and gangrene be imminent, amputate at the shoulder joint.

Ligature of the Axillary Artery.—The

line of the artery is from the lower border of the first rib to the lower edge of the *teres major*. With the arm at right angles to the trunk, it occupies a line drawn from the middle of the clavicle to the inner edge of the *coraco-brachialis*. The patient is placed on his back, with the shoulders slightly raised, and the arm carried away from the side.

(a) *Ligature under the Clavicle*.—(1st Step.) Make an incision from the tip of the coracoid process $4\frac{1}{2}$ inches along the lower border of the clavicle, dividing the integuments, superficial fascia, and *pectoralis major*.—(2nd Step.) Carefully avoiding the trunk of the acromial thoracic, coming forward over the upper margin of the *pectoralis minor*; and the cephalic vein, crossing the axillary artery from without inwards to join the axillary vein, tear cautiously through the costo-coracoid fascia, the arm being brought close to the side.—(3rd Step.) The axillary vein now comes into view, completely concealing the artery, and must be pulled downwards and inwards, the nerves drawn outwards, and the ligature passed from below upwards, taking care not to include the posterior thoracic nerve.

Other Methods.—1. By separation of the *pectoralis major* and deltoid muscles, without dividing the fibres. 2. Instead of cutting through the substance of the *pectoralis major*, the artery may be exposed by making an incision along the groove between the two bellies of the muscle, commencing about an inch external to the sterno-clavicular joint, and extending outwards and downwards for at least three inches in the direction of the insertion of the muscle. 3. Erichsen advises “an incision from the centre of the clavicle, directly downwards in the course of the vessels, to the middle of the anterior fold of the axilla.” He divides the skin, superficial fascia, and *pectoralis major* in this line, and, if thought desirable, the *pectoralis minor*. He adds that the great division of muscular substance it entails need not leave any permanent weakness of the limb, as by proper position ready and direct union can be effected between the parts.

(b) *Ligature in the Axilla*.—(1st Step.) The arm being completely abducted, an incision three inches long must be made, beginning at the base of the axilla, at

the inner border of the *coraco-brachialis*, or the junction of the posterior and middle thirds of the axilla, parallel to the course of the artery, involving at first the skin and superficial fascia only.—(2nd Step.) The deep fascia must then be carefully scraped through, the forearm being bent.—(3rd Step.) The median nerve is drawn outwards, the axillary vein, with the internal cutaneous and ulnar nerves inwards, and the ligature passed from within outwards.

Ligature of the Brachial Artery.—The line of the artery begins at the lower border of the *teres major*, and ends opposite the neck of the radius. Its situation is indicated by a depression along the inner border of the biceps and *coraco-brachialis*.

(a) *Ligature at the middle of the arm*.—(1st Step.) The seat of election is this situation. An incision is made, three inches long, in the middle of the arm, along the inner border of the biceps, dividing the skin and superficial fascia, and exposing the deep fascia, and probably the basilic vein.—(2nd Step.) Drawing the latter aside, and flexing the elbow, divide the aponeurosis and expose the fibres of the biceps.—(3rd Step.) The biceps is drawn outwards, and the artery then exposed enclosed in its sheath, on which rests the median nerve; this is separated and pushed aside, the sheath opened, the vessel isolated from its two accompanying veins, and the needle passed from the side of the nerve.

(b) *At the bend of the elbow*.—(1st Step.) An oblique incision $2\frac{1}{2}$ inches long should be made over the artery on the inner side of the tendon of the biceps.—(2nd Step.) The tendinous aponeurosis having been slit up, the artery is seen, accompanied by its two veins, lying between the tendon of the biceps on the outer, and the median nerve on the inner side. The veins at the bend of the elbow must be divided as little as possible.

Anastomotic Circulation.—When a ligature is fixed at the upper part of the brachial or lower part of the axillary; between the descending acromial, the circumflex, and the other thoracics, with the superior profunda and muscular. If at the lower part of the brachial, between the superior profunda and the radial and interosseous recurrenents, and between

the inferior profunda and anastomotic, with the interosseous and ulnar recurrents.

Ligature of the Radial Artery.—(a) In the upper third. The line of the artery is from the outer side of the biceps tendon to a point half an inch internal to the styloid process of radius.—(1st Step.) An incision $2\frac{1}{2}$ inches long, is made in the line of the artery.—(2nd Step.) Recognise the edge of the supinator longus by its vertical fibres, and divide the aponeurosis along the ulnar side of it, exposing the fibres of the pronator teres.—(3rd Step.) Press apart the two muscles, separate the artery from its veins, and pass the ligature. (b) In the lower third. Make an incision two inches in length, and half-an-inch to the outside of the tendon of the flexor carpi radialis. Divide the skin and superficial and deep fasciæ. Separate the artery from its veins and pass the ligature.

Anastomotic Circulation.—With the ulnar by the superficial and deep palmar arches, with the interosseous by the deep palmar arch.

Ligature of the Ulnar Artery at the wrist.—The surgical line of the artery is drawn from the internal condyle of the humerus to the outer side of the pisiform bone. The hand being supine, make an incision two inches long to the radial side of the tendon of the flexor carpi ulnaris, dividing the skin and superficial fascia, then slit up the deep fascia on a director; flex the hand and draw the tendon of the flexor inwards, open the sheath, pass the ligature from within outwards.

Anastomotic circulation is with radial by superficial and deep palmar arches, with interosseous by deep palmar arch.

Aneurism of the Abdominal Aorta.—The symptoms, besides those common to all aneurisms, are weakness and pain on movement, wasting or other digestive disturbances, pain, continuous or paroxysmal in the epigastrium, hypogastrium, back or loins, according to the position of the aneurism at the front or back of the aorta. The pulsating tumour is generally fixed, its immobility with the motions of the diaphragm being very characteristic. Pulsation may be felt in the epigastrium, a little to the left of the middle line, rarely it inclines to the right. An aneurism may however exist

although no tumour can be perceived. The bruit de soufflet can in most cases be heard in the left vertebral groove, as well as in front. Murray writes, that the following symptoms are rare in aneurism, and contra-indicate the presence of that disease: Rapidity of the pulse, œdema of the lower extremities, ascites, enlargement of the superficial veins; the presence of pus, mucus, blood, or albumen in the urine, jaundice, mobility of the tumour without murmur, malignant cachexia of cancer, and the deposits of cancer or tubercle.

Duration varies from a few months to years, but after prominent symptoms have appeared, life is rarely prolonged beyond eighteen months. Death occurs from exhaustion, pressure on adjacent organs, or hæmorrhage.

Treatment.—1. Absolute rest, low diet, and iodide of potassium. 2. If unsuccessful, compression of the aorta on the proximal side by the abdominal tourniquet under prolonged anæsthesia, provided the aneurism is situated below the renal arteries, if above these, distal compression may be tried. The bowels should be well opened by an enema and aperients, and the bladder emptied; during anæsthesia, peptonised beef tea enemata and brandy per rectum should be administered; after consolidation of the aneurism, warmth to the extremities, and flannels are necessary.

Inguinal Aneurism arises from the external iliac or common femoral arteries.

Symptoms.—A tumour in the groin, at first soft and compressible, and presenting the usual characters of aneurism. It increases rapidly, and by pressure on the saphenous and femoral veins occasions œdema of the leg, and the anterior crural nerve being implicated, pain is produced in the leg and thigh. The patient walks with difficulty, and is unable to flex the thigh on the pelvis.

Diagnosis has to be made by a careful consideration of the history and accompanying symptoms, from abscess and osteo-aneurism, the only diseases with which it is likely to be confounded.

Treatment.—1. Compression, digital or instrumental, of the external iliac above, and the femoral below the aneurism, should be tried if possible. 2. Ligature of the external iliac.

Ligature of the External Iliac.—The

line of this artery is one drawn from the left of the umbilicus, to the centre of the space between the symphysis pubis, and the superior anterior iliac spine. The lower two-thirds of this line corresponds to the external iliac, the upper third to the common iliac.

(a) *Abernethy's Method.*—(1st Step.) A curved incision four inches long, with its convexity outwards, must be made through the skin, beginning at a point one inch to the inside and one inch above the anterior superior spine of the ilium, and extending to a spot midway between that spine and the symphysis, and half-an-inch above the middle line of Poupart's ligament. Divide the integuments, superficial fascia and the aponeurosis of the external oblique muscle.—(2nd Step.) Cut carefully the fibres of the internal oblique and transversalis muscles on a director.—(3rd Step.) The muscles being held aside by flat copper spatulæ, the fascia transversalis is carefully scratched through near the crest of the ilium, and divided on a director.—(4th Step.) The whole of the inner side of the wound is next drawn towards the middle line, the peritoneum being separated from its connexions with the iliac fossa by the surgeon's fingers. The artery can then be seen or felt at the bottom of the wound, resting on the inner side of the psoas. The vessel is cleared, and the ligature passed from the inner side to avoid the vein.

(a) *Sir Astley Cooper's Method.*—(1st Step.) A semilunar incision is made through the integuments in the direction of the fibres of the external oblique, extending from close to the anterior spine of the ilium to a little below the inner side of the inguinal ring, and about half an inch above Poupart's ligament.—(2nd Step.) The aponeurosis of the external oblique is exposed, and must be divided to the fullest extent of the wound.—(3rd Step.) On raising the flaps the spermatic cord is seen passing beneath the edge of the internal oblique and transversalis muscles. Some loose cellular tissue and fascia have now to be scratched through; and the finger being passed under the cord will come in contact with the external iliac artery close to the spot where the epigastric takes origin.—(4th Step.) The cul de sac of the peritoneum with the trans-

versalis fascia being drawn upwards by a copper spatula, the vessel is exposed covered by its sheath, and having the vein to the inner side; the sheath must now be cautiously opened, and the ligature passed from within outwards, taking care not to include the genito-erural nerve which lies on the artery.

If the tumour have reached so high that ligature of the external iliac be not practicable, the common iliac or even the aorta must be tied.

Accidents which may follow ligature of the external iliac.—1. Pulsation may return in the sac. 2. Secondary hæmorrhage. 3. Gangrene. 4. Peritonitis. 5. Tetanus.

Anastomotic Circulation.—Epigastric with the internal mammary; ilio-lumbar and the lumbar branches of the aorta, with the deep circumflex iliac branch of the external iliac; external pudics with the internal pudics; obturator, gluteal and sciatic with the internal and external circumflex, and perforating arteries of the deep femoral.

Ligature of the Common Iliac.—(1st Step.) From a point half an inch above the centre of Poupart's ligament, a crescentic incision is made, extending upwards and outwards so as to pass one inch inside the anterior spine of the ilium, and then prolonged upwards and inwards as far as necessary.—(2nd Step.) The incision is then carried through the different planes of muscular tissue (which are the same as in ligature (a) of the external iliac) with great caution, the parts being divided on a director, and the transversalis fascia exposed.—(3rd Step.) This must be carefully opened and freely divided, so as to expose the peritoneum.—(4th Step.) The latter is raised from the tumour and the iliac fossa, and supported along with the intestines by copper spatulæ. The external iliac will serve as a guide to the parent trunk.—(5th Step.) The vessel is separated from the vein and its fascia by the finger nail.

Anastomotic Circulation.—Middle hæmorrhoidal with the superior hæmorrhoidal; uterine and vesical with those of the opposite side; lateral sacral with the middle sacral; deep epigastric, circumflex iliac, and ilio-lumbar with the internal mammary, lower intercostal, and lumbar arteries; internal iliac and branches with those of the opposite side;

branch to the ureter from the internal iliac with the spermatic and artery to vas deferens; uterine with ovarian.

Ligature of the Abdominal Aorta has been performed several times, but never as yet with a successful result, but is admissible when thought necessary.

(a) *Through the Peritoneal cavity*.—(1st Step.) An incision is made in the linea alba extending from a point three inches above the umbilicus to one three inches below, and curving to one side to avoid the navel.—(2nd Step.) Divide the peritoneum on a director.—(3rd Step.) Press the intestines aside to the right, and tear through the peritoneum, covering the aorta at the back of the abdomen with the finger nail, separate the nerves from the front of the vessel, and pass the ligature from the outer side; cut both ends short and sew the wound accurately up.

(b) *Without wounding the Peritoneum*.—(1st Step.) Make an incision on the left side of the body from the tip of the last rib to the crest of the ilium, prolonging it along the crest as far as is necessary, and dividing the integuments, muscles, and transversalis fascia only as in ligature of the common iliac.—(2nd Step.) With the fingers carefully separate the peritoneum from the parts behind, until the aorta is felt, which must be cleaned with the finger nail, and the ligature passed from the outer side.

Anastomotic Circulation.—Internal mammary with the epigastric; superior and inferior mesenterics with the pelvic branches of the internal iliac; lumbar arteries with the intercostal, diaphragmatic, ilio-lumbar, and circumflex iliac; spinal branches with the sciatic and gluteal.

Popliteal Aneurism is more frequent than that of any artery of the body except the aorta. It is most common in males, and persons who ride much, also in athletic individuals addicted to running or jumping, and in sailors, barge-men, porters, engine-drivers, etc.

Symptoms.—A circumscribed pulsating tumour of the ham which occasions difficulty in straightening the leg. Pain down the calf of the leg, and in the sole of the foot from pressure on the popliteal nerve, and coldness and œdema of the leg and foot from pressure on the popliteal vein. When arising from the anterior part of the artery, it afflicts

the bone and the joint, causing caries and synovitis, and may ultimately burst into the joint. When situated at the back of the artery it increases rapidly, and has a strong tendency to become diffuse.

Treatment.—1. Compression and flexion may be tried with good chances of success. 2. For aneurisms of small size, in comparatively healthy patients, Esmarch's bandage is serviceable. 3. Ligature of the superficial femoral artery. 4. In cases where these measures have failed, or cannot be employed, or aneurism has ruptured, amputation through the thigh.

Ligature of the Superficial Femoral at the apex of Scarpa's triangle. The line of the artery extends from a point midway between the symphysis pubes and the spine of the ilium to the inner border of the patella; another line from the anterior iliac spine to the junction of the middle and lower thirds of the thigh cuts the line of the artery where it is covered by the sartorius, and should be the middle point of the incision.—(1st Step.) An incision is made in this line four inches long, beginning four finger's breadth below Poupart's ligament. This divides the skin and superficial fascia.—(2nd Step.) The fascia lata is divided carefully for the same extent. The inner margin of the sartorius is now in view (the fibres running downwards and inwards), and on holding this muscle aside the sheath of the vessels appears.—(3rd Step.) This must now be cautiously opened on the outer side, care being taken of the long saphenous nerve which is in front of the vessel.—(4th Step.) A small portion of the vessel is cleaned from its inner side, in close contact with the artery, to avoid the vein which is behind.

Accidents which may occur.—1. Wound of the femoral vein, which should be at once ligatured. 2. Secondary hæmorrhage, which requires pressure, digital or by a compress; if this be unsuccessful, the bleeding point is to be cut down on and a ligature reapplied, and should this fail, amputation is necessary. 3. Gangrene of the limb. 4. Return of pulsation in the sac treated by compression, especially digital, Esmarch's bandage, ligature of the external iliac, or amputation.

Anastomotic Circulation.—External

circumflex with the external articular of the popliteal; perforating with branches of the gluteal and sciatic; profunda branches with anastomotic and articular branches; obturator and internal circumflex with anastomotic and superior internal articular.

Aneurism of the Tibial Arteries is very rare, but wounds not unfrequently occasion hæmorrhage which requires the arteries involved to be deligated.

Ligature of the Posterior Tibial.—(a) Through the middle of the calf (Guthrie). Line of the artery is from the middle of the popliteal space to midway between the tendo Achillis and internal malleolus.—(1st Step.) Beginning at the lower angle of the popliteal space make an incision six inches in length directly downwards, avoiding, as far as possible, the superficial veins, and dividing the skin and superficial fascia.—(2nd Step.) The deep fascia having been divided, the heads of the gastrocnemius are cut to the same extent.—(3rd Step.) The soleus is divided and its deep aponeurotic attachment carefully slit up.—(4th Step.) Separate the artery from the vein and nerve which are superficial to it, and pass the ligature from their side.

(b) The Lateral Method (the best). Flex the leg on the thigh and extend the foot, and place the leg on its outer side.—(1st Step.) Make an incision from four to six inches in length parallel to, and half an inch posterior to, the inner margin of the tibia, taking care to avoid the internal saphenous vein and nerve; this divides the skin and superficial fascia.—(2nd Step.) Divide the deep fascia and draw the gastrocnemius backwards.—(3rd Step.) A little dissection will expose the inner head of the soleus where it is attached to the tibia; this is fleshy externally and tendinous on its deep surface; the fleshy fibres are divided to the full extent of the wound, and then the tendinous cut through not too near tibia; and the muscle being slightly

raised, the artery will be found from 1 in. to 1½ ins. from the edge of the tibia, bound down by the deep fascia.—(4th Step.) This being cut through, the artery is to be secured, the needle being passed from without inwards. If care be not taken the tendinous portion of the soleus will be mistaken for the deep fascia, and the artery may not be found.

Anastomotic Circulation.—The anterior tibial with the external plantar and anterior peroneal.

(c) *Ligature at the Lower Third.*—An incision is made parallel with the inner edge of the tibia, and a finger's breadth behind it. After dividing the skin and superficial fascia, the deep fascia must be laid open; under this the artery will be found, accompanied by two veins which must be separated, and the ligature passed. The tendons of the tibialis posticus, and the flexor communis lie in front of it, and the posterior tibial nerve behind.

Ligature of the Anterior Tibial.—The line of the artery is from the head of the fibula to a point in front of the ankle midway between the two malleoli. An oblique incision three inches long is made, commencing at the outer edge of the tibia, and going downwards and outwards for two inches from the bone. The skin and superficial fascia are divided, and the outer border of the tibialis anticus sought for and recognised by the first white line external to the tibia; the foot being extended, the fascia is divided over this line, and the vessel lies surrounded by its venæ comites deeply between the muscles which must be separated. Pass the ligature from the side of the nerve. Much assistance is derived in discovering the vessel by tracing back its branches, which are given off in considerable numbers to the muscles around (Moore).

Anastomotic Circulation.—Anterior perineal with external malleolar; external plantar with anterior tibial, digital, and interosseous branches.

CHAPTER XXI.

INJURIES AND DISEASES OF VEINS.

Wounds.—When veins are cut across, dark purple blood is poured out in a steady continuous stream, which is increased on compressing the main blood vessels on the cardiac side of the wound, and this, together with the colour and steadiness of the flow, serves as a distinguishing mark from arterial hæmorrhage. If the vein concerned be one of the large trunks, the flow of blood may prove fatal. Pressure on the distal side will stop the bleeding. Contused and lacerated wounds of veins may be caused by the passage of a heavy body, as the wheel of a cart, over the trunk or limbs.

Treatment.—The hæmorrhage is readily controlled by attention to position, and the pressure of a graduated compress and roller. If the situation be one where pressure is not available, a catgut ligature or acupressure should be applied to both ends. At one time the ligature of a vein was dreaded from the possibility of the occurrence of phlebitis, but this risk has been much exaggerated. A practical point to be remembered is that the vein must be completely occluded by the ligature, and completely divided if the wound in its coats be only partial. Wounds of veins heal like arteries, by inflammation at the seat of the wound, followed by the formation of a cicatrix; but the blood pressure in the veins being feeble the margins of the wound are not separated during repair, nor the vessel obliterated.

Phlebitis.—Inflammation of the veins is more common than that of arteries, and in many cases is secondary to thrombosis (*q.v.*), the coagulum irritating the coat of the vessel, or to inflammation of surrounding structures; in others it results from a wound or injury, and very rarely is idiopathic from gout, syphilis, or exposure to wet and cold.

Pathology.—The inner coat of the veins is like that of the arteries, non-vascular, and in consequence of this acute inflammatory changes are confined to the external and middle coats. These become infiltrated with small cells, as

has been described in inflammation of arteries, the intima loses its vitality, the blood within the vein coagulating.

Symptoms.—1. The inflamed veins are hard, swollen, knobbed, and painful, the knots being situated opposite the valves. 2. If superficial veins be affected, redness of a bright or purplish colour over them. 3. Pain, stiffness, and difficulty in moving the part. Pain is in some cases slight, but when the deep veins are affected, of a severe neuralgic character with subfascial œdema. 4. Tenderness on pressure. 5. Œdema of the limb, especially when the deep veins are implicated. 6. Fever (100° to 101°).

Treatment.—Belladonna and glycerine, hot fomentations, and rest. Solutions of acetate of lead and opium are of service. If phlebitis be superficial, leeches or a blister over its seat are good remedies. If abscesses form they must be evacuated. The hardness which is left after removal of the inflammation is best treated by poultices of common salt and nitrate of potash, and iodide of potassium internally. To relieve the œdema a flannel roller is advantageous.

General.—Salines and purgatives. Opium, morphia, or chloral to relieve the pain. In local adhesive phlebitis the prognosis is favourable both as regards life and permanent obstruction in the vein.

Diffuse Suppurative Phlebitis is a very grave disease, due to infection with putrefactive organisms. It may occur with or without external breach of surface, and especially follows pyæmia, septic cellulitis, injuries or operations on bones, wounds of veins, diseases of bone, particularly the cranium. The inflammation runs along the cellular tissue surrounding the vein, secondarily attacking its coats, which become thickened, congested, and swollen. Abscesses form round the vessel. Thrombosis occurs followed by yellow softening, the clot breaking down into pus-like, creamy pulp, consisting of granular debris, pus, and micrococci.

Symptoms.—If the superficial veins

be implicated, the symptoms already mentioned, followed by rapid suppuration and sloughing; but if the deep veins be affected there will be marked tenderness along the course of the vein on firm pressure; limb will be hard and enlarged, but does not pit on pressure, though suppuration soon follows, and even gangrene. Erratic spots of erysipelas are met with in some instances.

General.—Feeble, fluttering, rapid pulse; rigors; brown tongue, sordes on the teeth, diarrhoea, vomiting; pinched countenance with anxiety, irritability and restlessness; extreme exhaustion, delirium, high continuous temperature (103° F. to 105° F.), and death. These symptoms are due to septic emboli being formed in the vein, and occasionally blood poisoning (*vide* Septicæmia and Pyæmia).

Treatment is the same as for Pyæmia (*q.v.*).

Phleboliths or vein stones are sometimes met with, varying in size from a currant to a pea. In form oval or spherical, in consistence hard and brittle, in colour reddish brown, yellowish, or bluish; they result from calcareous degeneration of laminated thrombi. They consist of carbonate and phosphate of lime, with 20 per cent. of protein matter, and a little sulphate of lime and potash, and traces of oxide of iron. The number varies from ten to thirty, and they are most common in the pelvic and saphenous veins, being often associated with a varicose condition.

Varix or Varicose Vein consists of a dilatation and thinning, followed by thickening of the veins, which are at the same time elongated, constituting a tortuous swelling. The inner coat is thickened and thrown into ridges, the middle coat may be also thickened, or may be thinned, and even absent; the outer coat is not much altered. The valves are always defective, being bent backwards or ruptured. The coils formed by the vein are joined by thick fibrous bands, which also connect the vein with the skin. The varicose condition occasions œdema, tension, pain and weakness of the part concerned; it also renders the vein liable to chronic inflammation, ulceration, hæmorrhage, thrombosis, and the formation of phleboliths. When the leg is affected the obstruction to the return of the venous blood gives rise to congestion

and thinning of the skin, followed often by inflammation, eczema, and ulceration. Agnew writes: "That in all cases of varices of the leg, the deep veins as well as those which establish a connexion between the two sets are affected similarly to the subcutaneous ones, and in all probability take precedence in the dilatation."

Locality.—The internal saphenous, hæmorrhoidal, spermatic, and vulval veins are the most common seats of the disease.

Causes are those inducing permanent distension of the vein, by weakening its walls and increasing the blood pressure. In some cases the predisposition to a varicose condition may be hereditary.—

1. Strain or over-exertion of a part.
2. Organic affections of the heart.
3. Obstruction of the portal system.
4. Occupations which favour gravitation of blood, as in omnibus conductors, washerwomen, policemen, etc.
5. Length of a vein, as in the internal saphena.
6. Pressure on veins within and without the body, producing an obstacle to the return of blood from a part, as in pregnancy, over-tight gartering, etc.
7. Tall stature and weakness.
8. Age: most frequently varices begin from twenty-five to thirty-five.
9. Gout.
10. Degeneration of veins.
11. Disorders of menstruation.
12. Injuries, as fractures, lacerations, burns, etc., are not unfrequently followed by obstruction of the neighbouring veins, leading to a varicose state of the veins below the blocked seat. The disease is said to be more common in men than women, but in my experience it affects both sexes about equally.

Treatment.—1. Palliative. Avoidance of the upright position, and a pad of cotton wool, with a bandage. Martin's rubber bandage. A well-fitting elastic stocking applied outside a thin angola or silk stocking whilst the limb is elevated. It should be removed at night, and the limb bathed in cold water and well shampooed. A flannel roller carefully applied, and outside this a second roller stiffened by plaster of Paris, starch, or liquid glass, may be worn for some weeks. Strapping is often of service. Garters should not be worn. Lotions of tinct. hamamelis (3j to Oj) are useful. Injections of ergotine or dilute alcohol subcutaneously into the tissues round the veins will often cause them to shrink.

If a varix burst in the leg, violent hæmorrhage ensues from the *cardiac* side of the vein, owing to the defective state of the valves. The patient must be at once placed in the horizontal position, with the leg much elevated, and a compress and bandage applied, the leg being kept at rest for a week. 2. Radical. (*a*) Subcutaneous section of the vein, or excision of a portion of it under aseptic precautions. (*b*) Making an eschar with caustic over the vein at a sound part of its course above the varix. 3. Galvanopuncture. 4. Injection of perchloride of iron or tannin into the vein. The following prescription is recommended:

R Iodinii gr. xv
Acid. tannic. ʒss
Aq. destill. f ʒxvj
m x to xxv for one injection (Vallette).

5. Acupressure, or compression of the vessel at several points. Pass a needle transversely behind the vein, and a small portion of elastic bougie having been placed on the skin over and at a right angle with the needle, constrict the whole by a figure of 8 suture. Care must be taken to pass the needle behind and not through the vein; the needles should be left in a week or ten days. Subcutaneous division of the vein may be conjoined with this method after a lapse of forty-eight hours, the vein being cut between the two pins. It is advisable to obstruct the circulation in the vein by acupressure before using any of the previous plans of treatment. The patient must be kept in bed until obliteration of the vein has occurred, and a generous diet must be allowed. 6. Ligature of the vein with prepared catgut in several places, under aseptic precautions. If there be chronic

œdema or much thickening of the tissues, no operation is to be performed.

Air in Veins may enter during operations on the neck and axilla, and also in the uterine veins.

Causes.—1. Suction due to the inspiratory movements of the thorax. 2. Gaping of the mouth of a wounded vein: (*a*) from adherence of the vein to the fascia, or muscular movements; (*β*) from canalisation of veins, these being converted into rigid tubes from inflammatory thickening of the vessel or the connective tissue round it, or from the vein being embedded in a tumour; (*γ*) in manipulations in the course of an operation.

Death generally follows either immediately or in a few hours.

Symptoms.—A hissing or bubbling sound, with the appearance of bubbles about the wound in the vein, followed by syncope or convulsions. A churning noise is heard in the heart synchronous with the ventricular systole; the hand applied to the chest feels a peculiar bubbling, thrilling, rasping sensation, occasioned by the air and blood being whipped together in the ventricle.

Treatment.—Preventive consists in applying pressure or ligature to the vein. When the accident occurs, at once seize the vein, and if this cannot readily be performed, Treves recommends that the wound should be filled with water, and the chest compressed during expiration. Hypodermic injection of ether, brandy per rectum, ammonia to nostrils, mustard poultices over the cardiac region and faradisation. Keep the patient horizontal, *do not use* artificial respiration, but raise the extremities and compress the femoral and axillary arteries.

CHAPTER XXII.

INJURIES AND DISEASES OF THE NERVES.

Compression of a nerve may be rapid or slow.

Causes.—*Of rapid.* 1. Traumatic. A strained and unnatural position during sleep. Pressure from a band, fetter, reins, handle of basket or bucket, crutch, dislocated bone, etc. 2. Inflammatory lesions from compression by plastic inflammatory matter in the sur-

rounding structures. Pressure of callus.—

Of slow. Growth of tumours in the cellular sheath or substance of nerves, tumefaction in the spinal cord, either meningeal (sarcoma, psammoma, echinococcus, etc.), or extrameningeal (carcinoma, sarcoma, hydatid, abscess), or vertebral (Pott's disease, cancer of the vertebra).

Symptoms.—Of rapid. Pain, formation; hyperæsthesia, numbness, motor paralysis. Loss of sensibility, but sensation returns before motion. Slow atrophy sometimes follows. Electromuscular contractility may be increased, diminished, or not altered. In some cases sensation of cold in the part.—*Of slow.* Pain in the periphery supplied by the nerve increased on motion. Hyperæsthesia at first followed by painful anæsthesia. Paralysis is not always present. Trophic disturbances, as herpes zoster, bullous eruptions, localised gangrene, joint affections, and muscular atrophy.

Prognosis depends on whether the cause can be removed, and the duration of the disease. Favourable, if the muscles still contract to the faradic current.

Treatment.—Remove the cause, and try galvanism followed by faradism of the muscles with massage.

Contusion.—When a nerve is bruised blood is effused in the interstitial connective tissue, pain ensues at the part struck, and a tingling sensation and numbness at the periphery where the nerve is distributed. These symptoms usually pass away in a short time, but sometimes severe neuralgic pains persist, this being due in many cases to a thickening of the neurilemma. If the contusion be violent, paralysis occurs immediately, or at an interval of weeks or months, and occasionally muscular atrophy.

Puncture of a nerve produces acute pain radiating towards the periphery and towards the root of the nerve, and even paralysis. But spasmodic movements, as contractions of the limb, tremors of muscles, and convulsions are more common.

Division.—On section of a nerve, the part to which it is distributed immediately loses the power of sensation and voluntary motion, but sometimes there are jerkings, tremblings, and tonic and clonic spasms: the nutrition of the site becomes affected, it being prone to ulcerate, and slough, colder than natural, œdematous and congested. Together with this paralysis, neuralgic pains and various sensations are felt. The limb becomes emaciated and the muscles wasted, in three weeks after the division of the nerve, and not only so, but they become actually shortened, and thus

may interfere with the action of other groups.

Alterations of Joints and Bones.—If the nerve supply a joint it is often subject to painful swelling, lasting for weeks or months, and keeping the joint stiff and sore; the tissues about the articulation being indurated may result in partial ankylosis.

Other changes which may follow injuries to nerves.—1. Increase, followed by diminution of temperature in the part supplied by the injured nerve. 2. Affections of the skin, as erythema, vesicular eruptions and ulcers. 3. Alteration of secretions, which may be diminished or excessive. 4. Local gangrene. 5. Atrophy and contraction of muscles (this is said to be most common after partial division.)

Results.—After a nerve is divided, for a few days the irritability is increased both to galvanism and faradism, but gradually the nerve loses its irritability to both currents. The muscle supplied by the nerve is deprived of its irritability to faradism from seven to fourteen days after the injury, and in a few weeks may not respond at all. As faradic irritability disappears, galvanic increases, due to the action of the continuous current on the intramuscular nerves, and the same time the anodal closure contraction equals or surpasses the cathodal closure contraction. (Reaction of degeneration.) Finally, as the muscle wastes a diminution sets in to the galvanic current, terminating in loss of response to both kinds of electricity. The nerve may unite, when the symptoms gradually disappear, voluntary contractility often recurring before electric contractility; in some cases a neuroma may form, producing intense agonising darting pains.

Repair.—When a nerve is simply cut there is first degeneration of the medullary sheath and axis cylinder, for a certain distance from the injury, followed by the production of cells in the neurilemma, which develop into spindle cells and spread into the tissue intervening beneath the nerve fibrils, from these cells new nerve fibres are produced. If a portion of the nerve be cut out, and the ends be widely separated, the function is not restored.

Treatment.—For paralysis, galvanism at first and then faradism, with blisters

and massage. Relieve the painful sensations with belladonna, opium, and glycerine, also the applications for neuralgia (*q.v.*). Divided nerve should be brought together by suture, and the limb fixed on a splint; if a nerve have been divided and the ends be not in apposition even after the interval of some weeks or longer, they must be cut down on, freely separated, freshened and united with fine kangaroo tendon, cat-gut, or fine carbolised silk sutures passed through the sheath; or if this be insufficient, through the sheath and nerve, in the direction of its long axis. From three to six sutures are necessary, and strict aseptic precautions. Improvement may not ensue for some weeks or months after suture. Should a neuroma form it must be carefully dissected out.

Neuritis, or inflammation of the nerve and its neurilemma, may follow rheumatism, traumatic injury, as wounds, strains, etc., typhoid and the eruptive fevers, alcoholism, syphilis, leprosy, lead poisoning, inflammation of neighbouring tissues, alterations in the blood, cold and dampness.

Symptoms.—Boring, darting, or shooting pains along the course of the nerve and along neighbouring nerves. The pain is continuous, and never *suddenly* intermits, but gradually increases, and gradually fades away. Tenderness on pressure. On moving the muscles the pain is often augmented, and firm pressure will frequently relieve it. There is fever. Hyperæsthesia occurs at first, followed by anæsthesia. The skin may be affected by various affections, as bullæ, eczema, etc. Local paralysis may be present, and occasionally spasmodic movements, as twitching, cramps, and tonic or clonic contractions. Vaso-motor system is often disturbed, and atrophy of muscles may ensue.

Pathology.—In acute neuritis, swelling, redness, and serous exudation into the cellular tissue of the nerve. The outer sheath and interstitial sheaths of nervous fasciculi are congested, and small ecchymoses may be present; later on the nerve is softened and broken up, and the nerve tubes form a soft brownish mass. This is followed by fatty degeneration. In chronic neuritis the nerve is frequently bluish or almost violet, swollen, and at various parts nodosities present themselves. In perineuritis the outer sheath

is alone generally implicated, and the nerve fibres are healthy, but if the interstitial sheaths be also invaded the nerve fibres atrophy from pressure.

Treatment.—Cupping, leeches, poppy and chamomile fomentations, or belladonna and glycerine. In some cases ice poultices give more relief than heat. Internally antimony, belladonna and opium, and aconite. In rheumatic neuritis, colchicum and alkalies. When chronic, with nocturnal exacerbations, iodide of potassium, actual cautery, blisters, tonics, spare diet and purgatives, galvanism.

Neuralgia. Symptoms.—Pain either following the anatomical course of a nerve or located at a point on the surface, without local signs of inflammation or disease. This pain varies in intensity, but may be remittent and severe, of a darting or boring character, or continuous, with a sensation of tension, pressure, and aching. Pressure sometimes relieves it, at others increases it. It may be periodic, coming on at certain intervals. The duration is uncertain.

Situation.—Any nerve may be implicated, but the most common sites are the fifth nerve, especially the infra-orbital, temporal, and dental branches. The intercostal nerves. The testicle, uterus, ovary, breast, knees, and hip joints.

Causes.—Local. Compression or irritation of nerve trunks, from induration of the neurilemma, pressure of a new growth, foreign body, periostitis of an osseous canal through which the nerve passes, necrosed bone, etc.—General. Want of tone and debility from exhausting diseases, mental worry, malarial poison, exposure to wet and cold, hysteria, anæmia, prolonged suckling, pregnancy, syphilis, Bright's disease, diabetes. Peripheral irritation acting in a reflex manner will produce neuralgia, as worms, constipation, decayed teeth, calculus, uterine disease, etc. Irritation or disease of the central nervous system, as a tumour, spinal caries, etc.

Diagnosis is made from neuritis by the presence of cutaneous sensibility, relief of pain on pressure, and the sudden onset and cessation of pain.

Treatment.—Remove the cause. If the patient be anæmic, give preparations of iron, strychnia, quinine, sea bathing or cold sponging, and fresh air. In hysteria, valerianate of zinc and assafa-

tida. In malaria, quinine and liquor arsenicalis. In the rheumatic, iodide of potassium with ammonia, opium, and belladonna, or colchicum and opium. The bowels must be kept well open with calomel and opium, alternating with ext. cascarae liquid. To relieve pain, opium, ether, belladonna, Indian hemp, croton chloral, hyoscyamine, bromide of potassium, eucalyptus oil, tr. gelsemin. semper-virens, ergot of rye, turpentine, calabar bean, chloride of barium, mercury until the gums are affected, are serviceable in different cases. Good food and fresh air.

Local Remedies.—Remove all sources of irritation, hypodermic injections of morphia combined with atropine, liniments of chloroform, belladonna, opium, aconitia, veratria, or ointments. The application of a galvanic current or faradism with a wire brush. Counter-irritation by blisters, actual cautery, liniment. iodi., or the following liniment:

R Ol. olivæ f ʒijss
Ol. terebinth. f ʒijss
Acid. sulph. fort. ʒj. Misc.

Intense irritation is produced by this application. Ether spray or ice or cocaine gr. v vaseline ʒj smeared over the part will procure temporary alleviation. Injections of a 1 per cent. solution of osmic acid into the tissues adjacent to the affected nerve; this causes at first pain and swelling, and must be repeated several times before the pain is removed. Section or excision of a portion of the nerve used to be performed in severe cases, but is worse than useless. However, a remedy which has given more favourable results, is cutting down on the nerve and stretching the fibres. The supra-orbital nerve can be reached at the junction of the inner with the middle third of the supra-orbital ridge. A line drawn from this point to the interval between the bicuspid teeth, passes over the infra-orbital and mental foramina.

Tetanus is a functional disease of the spinal cord, depending on peripheral irritation; or according to some authorities, a poison of the nature of a ptomaine is generated in the wound, and acts like strychnine on the motor nervous centres. Experiments performed by Nicolaier and Flügge have shown that many specimens of earth contain bacilli which, when introduced beneath the skin of rabbits

and mice, occasion tetanic symptoms and death. Inflammation does not occur at the seat of the inoculation, the bacteria only growing locally and not becoming diffused over the whole body. Rosenbach found the same bacilli in the case of tetanus in a man.

Causes.—Age. Most common from 16 to 25, but may be met with at all ages; in hot climates where great variations in the temperature are usual, it attacks new-born infants.—Sex. It is more common in the male. Bodily injury of any kind without solution of continuity in some cases, and very trivial wound in others, have given rise to this complaint; thus, the stroke of a whip, sting of a bee, etc. A punctured wound of, or ligature of a nerve, will frequently lead to tetanus. Lacerated or contused wounds of the hands, feet, or scalp, dividing a nervous twig. It may be idiopathic. Tetanus may supervene at any period within twenty-two days after the injury producing it.

Pathology.—The spinal cord may either present no *post mortem* change, or hyperæmia round the roots of the nerves, or hyperacute central myelitis.—Locally. The neurilemma of nerves is red at the seat of the injury, and occasionally ascending neuritis may be present. Foreign bodies may be detected in some cases.

Symptoms.—There are no premonitory symptoms. The patient first complains of pain and stiffness in the muscles of the neck, temples, and jaws, the mouth being opened with difficulty (trismus, third and fourth day after the injury, but may be later). The muscles of the fauces and pharynx may be spasmodically contracted, giving rise to sore throat. Next, the rigidity extends to the muscles of the trunk, invading the neck, throat, and abdomen, which are hard, tense, and rigid. The body is bent backwards, forming an arch (Opisthotonos), but may be stretched out straight (Orthotonos), very rarely drawn forwards (Emprosthotonos) or to one side (Pleurosthotonos.) In many cases the muscles of the hands and fingers escape altogether. Soon spasms arise, occurring in paroxysms, at first slight with considerable intervals, but increasing in severity and duration, and accompanied with severe pain. The spasms are tonic; that is, the spasmodic condition never

entirely relaxes through the whole course of the disease. During these convulsive attacks the patient is greatly distressed; the muscles are strongly contracted, back much curved, features convulsed, angles of the mouth drawn down in the risus sardonicus, and the face has an aged expression, with a peculiar look of anguish. Breathing is stopped from spasm of the diaphragm and other respiratory muscles, and is drawn with a loud sobbing sigh; there is also a severe feeling of constriction in the pit of the stomach shooting to the spine from the same cause. The voice is weak. There are a frequent and feeble pulse, and profuse sweats, with great heat of the surface. The patient is quite unable to swallow anything. The bowels are constipated and the urine may be retained. Sleep is impossible. *The intellect is not disturbed, and the patient continues intelligent to the last.* The temperature at the onset is about 102° Fahr., but towards the end the fever runs very high, 109° Fahr. to 112° Fahr. Death may occur early from failure of the heart, or respiratory spasm, later on from exhaustion. Tetanus is sometimes chronic, and in some cases the spasms commence at the seat of injury.

Prognosis is always unfavourable. The sooner the symptoms appear after the injury the worse will be the case. Survival beyond the fourth day is favourable. If the convulsive movements be severe and frequent, the sooner will a fatal result occur.

Diagnosis from strychnia poisoning is made by the facts that in poisoning severe symptoms appear suddenly, and in tetanus increase gradually in severity, and in poisoning the muscles are completely relaxed in the intervals between the convulsions, and the jaw is not locked except during the spasmodic attacks. The same differences exist between tetanus and hydrophobia. Hysterical trismus is distinguished by its history and progress. The presence of cerebral symptoms is a sufficient distinction from cerebro-spinal meningitis.

Treatment.—Keep the patient quiet in a room by himself, muslin curtains being placed round the bed, as convulsive exacerbations result from the lightest touch or draught of air. Clear the bowels out with a turpentine enema.

Remove any foreign body in the wound, and excise the ends of torn nerves, or stretch the nerve trunks. The limbs should be kept immersed for days in a warm water bath. Support the patient's strength by beef tea, peptonised milk, egg and brandy, administered by the rectum if the patient cannot swallow. It is well to remember that there is sufficient space behind the last molar tooth to introduce a catheter and give nourishment. Relieve the convulsions by chloroform inhalations. Cold to the spine by one of Chapman's bags or the ether spray. Almost every anodyne or anti-spasmodic drug in the Pharmacopæia has been tried; the best seem calabar bean, curare, nicotine, cannabis indica, chloral hydrate, bromide of potassium or ammonia, and morphia with atropine. These may be administered subcutaneously or per anum. Tracheotomy is of service to prevent laryngeal spasm and death from apnoea.

Hydrophobia.—Arises from the introduction of a special virus through an abrasion of structure. The poison exists in the saliva of dogs, wolves, foxes, and cats, etc., suffering from rabies.

Symptoms.—After a person is bitten by a rabid dog a period of incubation occurs, extending from forty to sixty days; but this may be longer or shorter. The premonitory symptoms are those of pyrexia, as loss of appetite, chilliness, headache, muscular soreness, discomfort about the throat, with great depression of spirits and irritability (melancholic stage). Then follow difficulty in deglutition and speech. Patient is very thirsty, but has a great aversion to liquids. Soon any attempt to drink produces convulsions, and the muscles of the pharynx and chest are contracted. Feeling of suffocation and difficulty in breathing. The voice is husky, pain at the epigastrium, eyes injected and the pupils dilated. Increased sexual desire. The pulse is small and frequent, but the mind is generally clear (period of excitement). As the case advances the pulse becomes weaker, and the convulsive attacks more frequent, until at last the patient dies of asphyxia or collapse. Paralysis may ensue. The course of the disease rarely extends beyond two or three days (stage of paralysis and exhaustion).

Pathology.—A poison the nature of

which is unknown, acting chiefly on the medulla oblongata and the brain.

Treatment.—When a person is bitten by a dog he should encourage bleeding from the wound, and at once have this cauterised with pure carbolic acid crystals, the opening being enlarged if necessary. To prevent rabies in dogs these animals should be compulsorily muzzled. When hydrophobia has developed itself, all treatment is of no avail. Injections of morphia and inhalations of chloroform and ether are the best palliative measures. Pasteur practises a prophylactic course of injection of hydrophobic virus cultivated by transmission through rabbits, and modified by exposure to dry air for some days. Whether this will be effective remains to be seen.

Nerve Stretching.—The weight which can be borne by nerves without breaking is very great in the limbs. The sciatic can bear a weight of 130 lbs., the ulnar and radial about 50 lbs. The extent to which nerves can be stretched is about two inches. Slight stretching will produce ecchymosis, congestion, and serous effusion of nerves; greater strain will be followed by degeneration. Slight stretching is accompanied by hyperæsthesia and increase of excitability; more pronounced stretching by anæsthesia and paralysis. Stretching of the nerve acts on the nervous centres, and through them on more distant nerves. If it be desired to reduce nervous action a considerable force should be applied.

Methods.—1. The bloodless operation. The patient is anæsthetised, the limb fully flexed at the joint nearest the trunk, the next joint is slowly and firmly extended, and when this has reached its fullest point the distal joint is also extended (if the ankle, flexed). The state of tension is maintained for a quarter of an hour, and the limb then thoroughly shampooed. If the vessels are diseased they may be ruptured. 2. Operation by incision. Under an anæsthetic a free incision is made in the course of the nerve, dividing the skin and superficial structures; the muscles are held aside by retractors; the nerve will then be distinguished resting beneath some fat, and surrounded with loose connective tissue. It is isolated with the knife and forceps, the forefinger passed beneath it, or a hook if the nerve be small. The nerve being grasped by the finger and thumb is pulled for about five minutes each way, from the body and towards it. The nerve is replaced, the wound closed and dressed aseptically, a splint being applied. When the wound has closed the patient is to try and move the limb as much as possible, and it should be well rubbed every day.

Cases benefited by Nerve Stretching.—Spasmodic contraction of muscles, especially if the irritation be in the nerve trunk, contracture, tetanus, reflex epilepsy, paralysis of motion depending on injury to nerve trunk, hyperæsthesia, neuralgia, sciatica, locomotor ataxy, and anæsthesia.

CHAPTER XXIII.

DISEASES OF THE LYMPHATICS.

Inflammation of the Lymphatics—*Lymphangitis, Lymphatitis, or Angiopleuritis.*

—*Causes.* Atmospheric changes, the early spring, debility, and neglect of sanitary measures. The direct cause is, as a rule, a poisoned wound, but it may occur without any breach of surface.

Symptoms.—In a patient suffering from a wound or injury, a rigor occurs, followed by considerable pyrexia. The injured part presents a number of fine red lines, which gradually unite, producing

a distinct band running along the inner side of the limb to the nearest lymphatic gland, which is tender and swollen. The inflammation seldom proceeds beyond the proximate gland. The part may be cedematous, pitting on pressure, or hard and brawny. There is a feeling of soreness, stiffness, and tenderness. Red patches of an erysipelatous nature and of some extent are often apparent. Should the deeper vessels be affected the glands will present the first symptoms,

and the limb feel hard and brawny, but without redness.

Results.—1. Resolution in from eight to ten days. 2. Erysipelas. 3. Suppuration, with the formation of abscesses along the inflamed line and in the glands. 4. Pyæmia. 5. A solid hypertrophy of the limb.

Diagnosis.—From erysipelas by the red streaks and tenderness of the glands; but both diseases often co-exist. From phlebitis by the absence of the knotted cord, and the presence of the red lines and affection of the glands.

Treatment.—Leeches, poppy fomentations, or linseed poultices, glycerine and belladonna. Warm lotions of lead and opium. Immersion of the limb in the local hot bath. The application of iodine or blistering fluid along the course of the affected vessels is sometimes advantageous. Keep the bowels open by a mixture of sulphate and carbonate of magnesia, or calomel and opium. Give salines with antimony, followed by liq. ferr. perchlor. To relieve pain, opium and belladonna. When the disease takes an adynamic form, stimulants, carbonate of ammonia, and plenty of easily assimilated nourishment. If chronic, blisters, painting with iodine or nitrate of silver, mercurial ointment, or oleate of mercury, and friction, careful bandaging with pressure by absorbent cotton, Martin's rubber bandage, etc. If abscesses form they should be at once opened, and drainage tubes inserted, as the skin is often much undermined.

Inflammation of the Lymphatic Glands, Adenitis or Lymphadenitis.—*Causes.*—As a sequence of lymphangitis, poisoned wounds, strains, over-exertion, any irritation, as pediculi capitis, decayed tooth, etc. It is important to remember that the lymphatic vessels follow the course of the blood vessels of a part in searching for the source of irritation or inflammation of a gland.

Symptoms.—The disease may be acute, subacute, or chronic. If acute, it generally is conjoined with lymphangitis. There are pain and swelling, the gland feeling like a hard painful knot, and rapidly increasing in size; tenderness, and stiffness about the inflamed gland; pyrexia, followed by suppuration and the formation of an abscess. The cellular tissue surrounding the gland becomes implicated, and the skin over it glazed

and red. The abscess often attains a large size, insidiously, especially in children. When subacute, the glands are painful, swollen and tender, and matted together by the lymph pressed out into the adjacent connective tissue. Abscesses are not so frequent, and generally peri-lymphatic, beginning in the circumjacent tissues.—*Chronic.* The glands are hard, tender, enlarged, and painful. If suppuration follow, the gland lies in the midst of the abscess cavity, the skin is of a dark blue purple colour, thin and undermined. The affection may last for years, at times advancing, and then receding again. In the neck it may be occasioned by cold, pediculi, disease of the jaw, ear, gum, or tonsil; in the groin by sores on the penis or buttock; in the thigh by lesions of the foot or leg; in the axilla from affections of the hand or mammary gland.

Strumous Enlargement of the Glands is met with in children. The glands are chronically enlarged, and after some time may suppurate; the skin is thin, dark blue or purple, and undermined, and the scars raised, prominent, and unstable. The pus is curdy and unhealthy. The disease is most common in the neck, and is characterised by its chronicity, spreading from one gland to another, its continuance after all sources of irritation are removed, and the large size the glands attain, together with other symptoms of struma. This enlargement must be carefully distinguished from syphilitic glandular affection, characterised by implication of the whole chain of lymphatics on both sides of the neck, along the anterior margin of the trapezius. The glands thus affected are painless, about the size of hazel nuts, indurated, but never suppurate. They become affected in this manner before any eruptions make their appearance, and continue sometimes long after any other symptoms (Miller).

Treatment.—In acute cases remove all sources of irritation, absolute rest, leeches and fomentations, belladonna and glycerine. Internally, a purgative, followed by a saline mixture containing vin. antimon. and opium. In subacute, evaporating lotions with iodide of potassium, or chloride of ammonia, and a moderate anti-inflammatory treatment. If abscesses arise they should be opened, and should the remains of the gland be seen these

should be enucleated,—nitrate of silver and iodoform are useful,—and all sinuses must be slit up, then drainage tubes should be inserted. When chronic, cod-liver oil, syrup of the iodide of iron, quinine, a mild mercurial course, and good food.—Locally. The iodide of starch, iodide of lead, or iodide of ammonia ointments, terebene, pressure with a pad and bandage, fly blisters. Injection of a few minims of tr. iodi. into the gland is recommended. When abscesses form, if there be much burrowing and undermining of tissue, slit up all sinuses, scrape with a Volkmann's spoon, and cover with skin grafting. Electrolysis is serviceable, and some surgeons use potassa fusa. The sulphide of calcium (1 gr. to O ss), as recommended by Ringer, is very advantageous when given internally.

Lymphadenoma (vide Tumours).

Elephantiasis of the Leg and Scrotum.—*Barbadoes Leg*.—*Elephantiasis Arabum*.—*Bucnemia Tropica* consists in a hyper-

trophy of the skin and connective tissue, generally of one of the lower limbs, the scrotum (sarcocele) or the labiæ, succeeding to repeated attacks of lymphangitis. The lymphatics are sometimes varicose. The cause appears to be residence in damp and moist climates, especially such as are tropical and malarious. The changes to which the disease is due are uncertain, though it is known the glands are impervious to lymph, which thus is effused into the connective tissue and produces the hypertrophic changes. It has been asserted that this result is due to the presence of filaria in the lymphatics, and this view is supported by the occasional co-existence of chyluria.

Treatment.—In the early stages, the same as for inflammation of the lymphatics; when chronic, friction, bandaging, mercurial inunction, and, as final measures, ligation of the main artery, and excision or amputation of the part.

SECTION 7.

INJURIES AND DISEASES OF THE HEAD, NECK, SPINE, AND CHEST.

CHAPTER XXIV.

INJURIES OF THE HEAD.

Contusion of the Scalp results from external violence, as blows, etc. The most common effect is hæmorrhage into the cellular tissue, producing a soft, round, sharply-defined semi-fluctuating swelling. This may simulate a fracture, the edges being hard and slightly thickened; it is distinguished by the finger penetrating the soft centre and feeling the subjacent healthy bone, and the edge, though hard, can be indented by the finger nail. However slight a contusion may appear it should always be regarded as important.

Complications and Sequelæ.—Contusion of bone, concussion of the brain, rupture of an artery, intracranial hæmorrhage, erysipelas, abscess, neuralgia, cephalhæmatoma, aneurism, pyæmia.

Treatment.—Rest in bed and evapo-

rating lotions, as spirit and water, or acetate of ammonia. If the injury be more extensive, warm lotions of opium and chloride of ammonia, acetate of lead, or spirits of camphor; and strapping the scalp, or pads of absorbent cotton with a bandage. On no account make an incision.

Cephalhæmatoma, or Blood Tumour of the Scalp, is often the consequence of a blow, and is frequent in the new-born infant, from pressure on the head during parturition. The blood is effused either between the aponeurosis of the occipito-frontalis and the pericranium (subaponeurotic), or beneath the pericranium, between that membrane and the bone (subpericranial), in which case it is limited to a single bone by the line of sutures. The skin is usually unchanged,

without discolouration. It is a remarkable circumstance that in some cases of pericranial hæmatoma, the membrane so raised will undergo extensive ossification.

Treatment.—Cold applications, as evaporating lotions, Leiter's coil, or ice. Maissoneuve's ice poultices. On a cloth of appropriate size lumps of ice are placed as big as a marble, over these linseed is sprinkled lightly, forming a layer three-quarters of an inch thick. This is covered with another cloth, and the edge folded in. The meal side is applied to the part. Afterwards pressure by a sponge, and then paint with tincture of iodine and use compression. If these means be unsuccessful, which is rarely the case, aseptic aspiration.

Wounds of the Scalp are similar to those in other regions, but more dangerous, owing to the liability to their being followed by erysipelas or cerebral mischief. From the vascularity of the scalp, wounds rapidly heal, and from the same cause bleeding is always profuse, the vessels being embedded in the subcutaneous fibrous tissue, to which their outer coats are attached, cannot retract well, thus increasing the hæmorrhage. Partial division of the vessels also contributes to the same result. These wounds do not gape. When the scalp is detached, forming a flap, it does not lose its vitality, as the vessels are carried with it. In contused wounds, made by blunt weapons used with force, the wound resembles an incised one, but is distinguished from the latter by the fact that on examining the surface entire hair bulbs will be seen projecting. In incised wounds these are always cut.

Treatment.—If a simple incised wound, the hair must be cut off round the injured part and the edges approximated, a pad of absorbent cotton being applied. When the wound is extensive, and the parts much separated, they must be kept in position by harelip pins and twisted sutures, or a few silver sutures and pads placed at each side of the wound; in this case the scalp should be well shaved. If there be excessive bleeding, cold, pressure, acupressure with figure of 8 suture, ligature, or torsion. When the scalp is detached from the bone it should be carefully cleansed with some antiseptic, *but no scalp substance should be removed*, it being retained in its place by a few silver sutures, a drainage tube in-

serted, or counter-opening made if necessary, and an aseptic dressing employed. Never use plaster for scalp wounds, as it retains the discharges, producing suppuration under occipito-frontalis aponeurosis. When pus forms under the aponeurosis, a probe is passed and counter-openings made parallel with the fibres of the occipito-frontalis, through which drainage tubes should be inserted. If erysipelas or cellulitis supervene, free opening for the pus by separating the edges of the wound, warm fomentations, poultices, and limited incisions. In sloughing of the scalp, obstinate bleeding is now and then met with, and in such cases Hewett recommends pressing over each main trunk until the one at fault is found, and then this should be controlled by a compress and roller, tying, or acupressure. After all scalp wounds the patient should rest in bed for some days, a purgative be administered, and his diet should be chiefly confined to milk. Stimulants are pernicious and must be avoided.

Injuries to the Skull.—Contusion of the bone is dangerous on account of its being apt to be followed by: 1. Separation of the periosteum and perhaps the endosteum, producing exfoliation of the outer table, or necrosis of the whole thickness of the bone. In some cases the disease is not limited to the bone injured, but spreads widely, and may even detach the whole vault; 2. Inflammatory hypertrophy of the bone; 3. Intracranial suppuration between the dura mater and the bone; 4. Inflammation of the diplöe, and pyæmia.

Fracture.—*Causes.*—External violence. Direct fracture occurs from violence applied to a part of the skull, which breaks and gives way at the locality involved. Indirect fracture from force not directly applied to the cranium, as a blow on the jaw, producing a fracture of the middle fossa. Fracture by contrecoup has no real existence.

Fractures of the skull may be divided into: 1. Fissured; 2. Depressed; 3. Punctured.

Fissured Fracture is a simple solution of continuity of the bone without any material displacement. It results from direct violence, and often traverses the base to a considerable extent. It is detected by carefully feeling along the bone with the finger nail or probe. Should the scalp be wounded it can

be seen as a red line due to effusion of blood between the lips of the fractured bone, which cannot be removed with a sponge. If there be no wound it cannot be detected. Care must be taken not to mistake a suture for a fissured fracture; the former is distinguished by its position, irregularity, and absence of a red line. Macewen points out another mistake which may occur in scalp wounds dividing the periosteum, but leaving one side of this membrane closely adherent to the skull while the other is raised exposing the bone. If the probe be used in such a case it meets the sharply cut edge of the periosteum, which gives the impression of a linear fracture; this error may be avoided by digital examination.

Complications.—External bleeding from the scalp; hæmorrhage from the middle meningeal artery; hæmorrhage from sinuses; extensive separation of the dura mater; wounds into dura, arachnoid, and brain; cerebral inflammation.

Treatment.—Cold applied to the shaven scalp by icebags, free purging, rest, and quiet.

Cephalhydrocele.—Simple fracture of the vault of the skull may give rise to a collection of cerebro-spinal fluid under the scalp, coming often from an opened ventricular cavity. Such traumatic cephalhydroceles may be developed quickly, or not for three or four months. It is only met with in young subjects, and is often fatal from cerebral inflammation or meningitis. It presents a soft, compressible tumour, covered with normal integument, which may be translucent. Pulsation is sometimes present, and the swelling is increased by crying or holding the breath. A similar fluid accumulation may occur after closure of the external wound in a compound fracture of the vault, or after trephining.

Treatment.—Aspiration when symptoms of compression are present.

Fracture of the Base of the Skull is a variety of fissured fracture, and may result from the extension of a fracture of the vault, produced by direct violence; or a blow on the head or fall from a height may occasion a fracture of the vault, and, in addition, a fractured base, by it being driven down on the spinal column; if the offending agent be a

yielding substance the base may be fractured in this manner without any break in the vault. Occasionally in brittle parts, as the orbit, fracture is induced by the penetration of foreign bodies. Indirect violence will result in fracture of the base, as when violence is applied from below upwards—for instance, in falls from a height on the feet or knees, the force reaching the skull indirectly by means of the spinal column, or a blow on the nose forcing in the ethmoid and fracturing the anterior fossa. Chassaignac and Hewett have both put on record a case of fracture of the base by the forcible projection of the condyle of the lower jaw against the glenoid cavity.

Symptoms.—The great danger of this accident is not so much the fracture, which is of trivial importance, but the serious damage done to the brain. It must never be forgotten that this injury may occur from a comparatively slight accident, as a fall on the pavement, the head striking the surface. When the *anterior fossa* is the part implicated there may be hæmorrhage from the nose, sub-conjunctival hæmorrhage, and extravasation into the eyelids, especially the lower. Vomiting of blood or bleeding from the mouth is occasionally met with, the blood running from the posterior nares into the pharynx. The blood is of a dark colour and mixed with food. Cerebro-spinal fluid may escape from the nose, but this is a rare event. Paralysis of the muscles of the eyeball. When the frontal lobes of the brain are involved there may be no cerebral symptoms for a day or two after the accident. If the *middle fossa* be implicated, profuse and continuous bleeding from the ear with rupture of the membrana tympani and discharge of cerebro-spinal fluid; vomiting of blood or bleeding from the mouth, the blood finding its way through the Eustachian tube into the pharynx, or as a rare event from rupture of the mucous membrane of the pharynx communicating with the seat of the fracture. If the blood come through the Eustachian tube, examination of the ear will reveal a dark distended tympanic membrane, and if the Eustachian catheter be passed blood will trickle through this. Insensibility is the rule, but there are exceptions. Paralysis of the fifth

and seventh nerves. In fractures of the *posterior fossa*, blood may be extravasated in the vicinity of the mastoid process, in the occipital region, or the side of the neck. There is pain on pressure over the mastoid process. Paralysis of the eighth and ninth nerves.

Hæmorrhage does not necessarily imply a fracture, but when accompanied by symptoms of compression or concussion, points to the seat of fracture. The most certain sign is escape of cerebro-spinal fluid which only presents a trace of albumen, does not coagulate on boiling or on the addition of nitric acid, is strongly saline from a considerable amount of chloride of sodium, and, as ascertained by Bernard, contains a small quantity of sugar. This watery fluid escapes from the subarachnoid space immediately after the injury, by the fracture implicating the meatus auditorius internus, and laying open the prolongation of the arachnoid membrane which accompanies the seventh nerves: occasionally the nose is also the seat of this discharge, the arachnoid prolongation around the olfactory nerves being involved. The quantity of this fluid is generally abundant. Other symptoms which may point to the seat of the lesion are injury to some of the cerebral nerves, producing blindness (optic nerve); paralysis of the muscles of the eyeball, and dilatation of the pupil (third nerve); paralysis of muscles of mastication and loss of sensation (fifth nerve); internal strabismus (sixth nerve); facial paralysis, drawing the features to the opposite side (seventh nerve); impairment of swallowing and the movements of the tongue (eighth and ninth nerves). The fall of temperature in fracture of the base of the skull is sometimes very remarkable; a decline to 87.4° F. in one and a half hours has been met with. Fractures of the base are very fatal, and in the event of recovery no union may take place for months or years. If union ensue it may be wholly bony, or partly fibrous and partly bony.

Treatment must be directed to the cerebral complications; operative interference is out of the question.

Depressed Fracture is usually comminuted, and may be compound or simple. The external table may be alone implicated, without any fracture of the internal; or the inner table may be

fractured and depressed, the external being uninjured. Teevan explains this by the fact that the fracture does not begin on the aspect of compression, but on that of extension, in obedience to that law by which a cane is fractured by being bent across the knee. More usually both tables are involved, the inner being much more extensively fractured than the outer, if the violence be applied externally, owing to the force spreading, the opening in the second table being made not only by the penetrating body, but also by fragments of bone being driven in from the proximal table, the brittleness of the inner table, and its forming a smaller curve; whilst, if the violence be applied to the internal table from within, the outer is more widely fractured. A depressed fracture may be masked by a superjacent extravasation of blood, if the periosteum over it be entire. Depression without fracture is met with in young children, but in many of these cases the internal plate is broken; the bone may recover itself or remain permanently depressed.

Symptoms.—In a simple depressed fracture the depression may be felt, but is often obscured by extravasation of blood, and can only be guessed at by the symptoms of compression which are present; in such a case it is best to cut down on the part and examine the bone. If the fracture be already compound, the finger is passed into the wound, and the exact state of the bone determined. It is a remarkable fact that no calculation of the bad effects can be made from the extent to which a part of the skull is depressed. Severe symptoms may follow slight depression, slight symptoms may ensue on marked depression; but when a small portion of bone is much depressed the symptoms are likely to be more severe than in a larger piece more slightly depressed. The dangers of depressed fracture are compression of the brain and inflammation, owing to the dura mater being wounded by spiculæ of bone.

Treatment.—If the scalp be entire, but there are symptoms of compression, a T-shaped incision should be made down to the bone, and if on examination it be found to be depressed, it should be raised or removed. If there be no symptoms of compression, opinions vary as to the proper course to be followed;

should the depression not exceed one-third of an inch it should be left alone, especially in children, as the bones are very elastic and the depression may disappear. If, however, the scalp be wounded and the depression sharp, small in extent, and deep (gutter or saucer-shaped fracture), it must be treated as a punctured fracture, and an early operation performed. In compound comminuted fractures all loose fragments of bone are to be taken away, and the depressed portion raised, or if wholly separated, removed, even if there be no symptoms of compression. In order to raise the bone trephining may be necessary. In compound fractures the chief indication is to obtain an aseptic condition of the wound by shaving the patient's head, washing it with soft soap, and then with ether or turpentine to remove greasy matter, and finally with carbolic acid (1 in 20.) Drainage is important, and an aseptic dressing fixed in position by elastic webbing. Iodoform should be dusted round the wound.

Trephining.—Cases in which it is useful: 1. Compression of the brain, due to depressed fracture, lodged foreign bodies, or extravasation of blood; 2. In cases of irritation of the brain from inflammation of the bone, splinters of bone, formation of the pus within the skull, etc. If the patient be not insensible give an anæsthetic, preferably chloroform. Examine the chest and abdomen before operating in cases of injury to the head with coma. This operation should always be done under aseptic precautions. A crucial, horse-shoe, V-shaped, or T-shaped incision is made through the skin, and the flaps raised, all bleeding vessels being secured. The pericranium is then divided crucially and detached by means of the handle of the scalpel over an extent large enough to hold the crown of the trephine. The periosteum should not be removed, as its preservation increases the probability of a reproduction of bone. The centre pin is then projected for $\frac{1}{16}$ th of an inch, and bored into the edge of the sound bone (in the case of a depressed fracture the trephine is so applied that one-third of its circle overlaps the edge of the fracture). On the pin as a centre the saw is then worked by to and fro semi-circular sweeps until it has cut a groove sufficiently deep to maintain its steady-

ness. The pin is then withdrawn, to avoid injuring the dura mater. The rotatory movements are continued, and the groove examined from time to time by a quill toothpick or probe, and the trephine cleaned with a brush. When disk is loose it is detached by the elevator or forceps, and the depressed bone raised with the elevator. When the diploe are reached blood will well up in the groove, and then the surgeon must proceed cautiously. The skin is replaced, a drainage tube inserted, and an aseptic dressing applied.

Macewen writes: "After having elevated the portions of bone from a depressed fracture, instead of leaving the brain and its coverings exposed, the bones so removed should be carefully preserved under aseptic conditions, until the completion of the operation, when they may be replaced, in part at least, so as to form an osseous wall over the aperture.

Instruments required.—1. Scalpel. 2. Trephines. 3. Hey's saw. 4. Elevator. 5. Dissecting forceps. 6. Brush to clear away bone dust (a wet sponge is better). 7. Probe. 8. Quill toothpick. 9. Lenticular knife. 10. Small polypus forceps. 11. Sponges. 12. Lint and absorbent cotton. 13. Ice. 14. Chloroform or ether, and inhaler. 15. Gouge forceps, or a small pair of bone forceps. 16. Artery forceps, torsion forceps, acupuncture needles and tenaculum. 17. Ligatures. 18. Sutures. 19. Aseptic dressing (*vide Wounds*).

Parts where the trephine should not be applied.—1. Over a sinus; the superior longitudinal sinus corresponds with a line drawn from the root of the nose to the occipital protuberance; the lateral sinus, with a line drawn from the occipital protuberance to the front border of the mastoid process. 2. Over the middle meningeal artery (except in meningeal hæmorrhage), at the inferior angle of the parietal bone, $1\frac{1}{2}$ inches behind and $1\frac{1}{2}$ inches above the external angular process of the frontal bone. 3. Over the occipital protuberance. 4. Over a suture. 5. Over the frontal sinus: if an operation here be imperative, two trephines must be used; a large one for the external, and a small one for the internal table.

Many cases of depressed fracture may be treated by the removal of the pro-

jecting portion of sound bone by strong bone forceps, or a Hey's saw, and the depressed portion raised by the elevator. It is to be remembered there are no diplöe in children or very aged persons.

Punctured Fractures are inflicted by sharp-pointed bodies, as a bayonet or pick-axe, or by falling from a height on a sharp-pointed body. The external table is, as a rule, but slightly injured, but the internal table is depressed in the form of a cone, and extensively splintered. The sharp edges of the splinters are apt to lacerate the membranes, or irritate them, causing inflammation.

Treatment.—In these cases there is not often compression, and the patient for a short time may present no cerebral symptoms; but though in abeyance their onset is inevitable, and thus it is the invariable rule in these cases to at once operate: a large trephine is used, and the fractured portion removed, with all splinters.

Cerebral Localisation.—For surgical purposes the cerebral centres are located by Lucas Championnière.—*Lower Extremity*, summit of the ascending parietal convolution. *Upper and Lower Extremity*, summit of the ascending frontal and parietal convolutions. *Upper Extremity*, middle portion of the ascending frontal convolution. *Upper Extremity and Aphasia*, inferior third of ascending frontal and foot of the third convolution. *Facial Paralysis*, inferior third of the ascending frontal and foot of the second frontal. *Aphasia*, foot of the third frontal. The ascending parietal and frontal convolutions can be located by their position to the fissure of Rolando.

To find the fissure of Rolando, the scalp is shaved, a piece of cardboard is taken and an arch cut out to fit the head, astride of which it is placed, passing across both external auditory meatuses. A common drawing-pencil is passed through the cardboard at each side at the level of the patient's eyes, to determine whether the head is exactly horizontal; the middle of the pasteboard indicates the bregma. This point is marked with an aniline pencil or tincture of iodine. Measure backwards $5\frac{1}{2}$ centimetres in a man, or 5 centimetres in a woman, which will indicate the top of the fissure of Rolando, and must also be marked. Finally, to find the lower end of the fissure of Rolando, measure back-

wards a horizontal line 7 centimetres in length from the external angular process of the frontal bone, where it begins to curve upwards to form the temporal ridge. At right angles to the end of this line let fall a perpendicular 3 centimetres long, which will give the lower end of the fissure of Rolando, and must be also marked. The points showing the upper and lower ends of the fissure of Rolando are then joined by the aniline pencil or tincture of iodine.

Varieties of Paralysis and Convulsions observed in Wounds of the Head.—The paralysis is opposite to the side injured.

1. Paralysis of the face and aphasia.
2. Aphasia and paralysis of the arm.
3. Paralysis of the arm and face.
4. Paralysis of the upper and lower extremity.

Total hemiplegia cannot have a cortical origin, and contra-indicates an operation, except when caused by abscess of the brain, or when incomplete, irregular, and co-existing with a deep depression of the bone on the opposite side. Then a trephine is to be applied to the middle of the fissure of Rolando. Monoplegia or spasms limited to one member or portion of a member point to a limited lesion. If the lower extremity be affected, trephine at the upper part of the fissure of Rolando. In paralysis of the arm and leg trephine at the upper part of the fissure of Rolando, but lower down than for the leg. In paralysis of the arm alone apply the trephine a little in front of the middle third of the fissure of Rolando. In paralysis of the face apply the trephine a little in front of the inferior third of the fissure of Rolando. In aphasia apply the trephine in front of and below the inferior extremity of the fissure of Rolando.

In complicated cases.—In paralysis of both lower extremities, the summit of the line and the bone immediately adjacent above this is to be removed by the trephine. In hemiplegia, the middle and upper parts. In paralysis of the arm, with facial paralysis, apply the trephine at the inferior third of the line. With facial paralysis and aphasia, the bone should be removed well in front of and below the inferior extremity of the line. In paralysis of the arm, with aphasia, remove bone below and in front of the line. In hemiplegia or hemispasm following injury to the temporo-parietal region, however slight the injury,

the surgeon is justified in exploring the motor area, also in coma from intracranial hæmorrhage, cerebral localisation is a guide. Lesions of base of brain, shown by implication of cranial nerves, neuro-retinitis or Cheyne-Stokes respiration, are positive indications *not* to operate, also hemiplegia with marked anæsthesia.

Injuries of Dura Mater and Brain vary in extent. From a blow causing an undepressed fracture, or even unaccompanied by fracture, the brain is frequently lacerated, and this frequently occurs on the opposite side to that struck, by contre-coup or counter-stroke. In depressed fracture the spiculæ of bone are forcibly driven into the substance of the membranes and into the brain substance. Bullet wounds or stabs and punctures through thin parts of the skull may also wound the brain.

Symptoms vary in degree and extent, being generally less severe in children. Together with the usual signs of compression, concussion, or irritation, there are convulsions, contraction of the pupil of the opposite eye (pin's point contraction), spasmodic rigidity, hemiplegia (on the opposite side to that injured), motor and sensory paralysis, paralysis of cerebral nerves, saccharine diabetes. The short sketch of cerebral localisation will serve to show the situation of the lesion.

Treatment.—Antiphlogistic. All sources of irritation must be removed, and aseptic dressings applied, the patient being kept perfectly quiet.

Hernia Cerebri, or Fungus Cerebri, is most common in the frontal and parietal regions; if there be an opening in the dura mater it may be produced quickly, if not, slowly. In the former case, blood or inflammatory products are poured out into the ventricles or subarachnoid space, forcing the brain out. Cerebral symptoms often accompany this complication (true hernia cerebri). In the latter, inflammation arises, plastic matter is effused from the vessels, accompanied by proliferation of the connective-tissue elements of the brain, forming a granulation tissue, and thus its bulk being increased, the cerebral substance finds its way in the direction of least resistance, as where there is loss of bone (false hernia cerebri). Cerebral hernia occurring at the time of, or soon after, the injury, retains the white appearance

of brain matter; but when formed at a latter period is greyish red.

Symptoms.—Hernia cerebri rarely occurs before second day, but may be much later. The fungus varies in size and shape, according to the aperture in the dura mater, but resembles a mushroom, as it gradually enlarges in bulk, overlapping the edges of the opening; its surface is rough, and it breaks down and sloughs, being replaced by fresh protrusions. It may shrink or slough off, cicatrization ensuing, but death is a more common termination. It does not possess much sensibility, but is very vascular, readily bleeding, elastic and compressible, and moves synchronously with the pulsations of the brain.

Treatment.—In the second case, 1 in 1,000 perchloride of mercury solution as a wash, and the part covered with sublimated wood wool, or apply astringents, as tannin, sulphate of copper or zinc, and pressure. All foreign bodies must be removed. In the true cerebral hernia any interference is useless, but it has been proposed to aspirate the fluid from the ventricles.

Intra-cranial Hæmorrhage.—Causes.—It may accompany a fracture when it is produced by either a fissure tearing across one of the meningeal arteries, or the opening of a sinus by spiculæ of bone, or from laceration of the brain and its capillaries, which frequently occurs on the opposite side to the part struck (laceration by contre-coup), and is most common at the under surface of the anterior and middle lobes, the brain being driven against the great irregularities of the bone on the inner surface of the base of the skull. It may also arise in consequence of wounds of the vessels from foreign bodies, as bullets. Occasionally the extravasation results from very trifling causes, as a slight blow on the head, without bruising of the scalp or fracture of the skull, particularly if the middle meningeal artery be the seat of the hæmorrhage. Lastly, it may follow concussion from rupture of small vessels at the time of the accident. Whilst the patient is in a state of collapse there is no bleeding, but as reaction appears, and returning sensibility with increased cardiac force, oozing takes place, and symptoms of compression ensue at a greater or less interval.

Situations.—1. Between the dura

mater and the bone, from (a) small vessels passing between these places; (b) the middle meningeal artery (most common); (c) from a sinus. 2. Within the arachnoid cavity. 3. Upon the surface of the brain. 4. In the brain substance, or within the ventricles.

Results.—Compression of the brain, which frequently causes death. The extravasated blood usually coagulates, forming an irregular, dark-coloured mass; this may be entirely absorbed, or the serum and colouring matter only, leaving a buff-coloured clot of fibrin, which may become organised, or a cavity may form in the centre of the clot containing fluid and changed blood.

Symptoms: present two distinct types.—

1. There is a period of concussion, followed by a *return of consciousness*, and then symptoms of compression arise with general paralysis, or hemiplegia of the opposite side to that injured (meningeal hæmorrhage). With the onset of the compression symptoms the pulse falls in frequency (60 to 40 per minute), the pupil is sluggish, and headache is complained of. 2. There is no return of consciousness, but the state of concussion passes into that of compression, partial paralysis, rigidity, convulsions, squinting, pupils unequally dilated (cerebral hæmorrhage).

Diagnosis.—From compression produced by a depressed fracture, hæmorrhage is known by, in the former case, the symptoms being immediate and continuing from the time of injury, and by detecting the injured bone. From inflammatory effusion, by this being preceded by cerebritis or meningitis. From apoplexy, by the history of the case. From drunkenness, by the absence of local symptoms, smell of the breath, the pupils being contracted but dilating fully and slowly on attempting to rouse the person, and by the face in drunkenness being flushed and swollen, but as a rule, pale in head injuries. The temperature is considerably below normal in drunkenness, but this is frequently the case in head injuries. Opium poisoning is recognised by the smell of the breath and the state of the pupil, together with the history of the case.

Treatment.—In cerebral hæmorrhage the head is to be shaved, icebag applied, or Leiter's coil, and free bleeding and active purging, with rest and quiet, and

a light diet. Subcutaneous injection of ergotin is useful. The most valuable drug is mercury, which should be freely and early used in the form of calomel, gr. iij every six hours. When the case has become chronic, iodide of potassium. In meningeal hæmorrhage apply a large trephine, $1\frac{1}{2}$ inches behind and half an inch above the external angular process of the frontal bone on the opposite side to that paralysed, which is usually the same side where marks of injury are situated; clear out the clots, and if the bleeding still continue, seize the vessel and dura mater with springforceps, and keep it compressed for twenty-four or forty-eight hours. If the artery be found to lie in a bony canal it may be stuffed with wax or lint, a sharpened match, or plugged with a red-hot knitting needle. If the bleeding cannot be controlled, it is admissible to tie the carotid artery. After trephining on the one side, if no hæmorrhage is seen, Spence advises trephining on the opposite side, as bleeding may have taken place here from contre-coup.

Effects of Injuries on the Brain.—*Concussion* arises from any injury which produces a jarring or commotion of the brain substance, resulting in injury and loss of function of the nervous particles. Huguenin considers that concussion is due to reflex paralysis of the intracranial vessels, the result of a powerful peripheral irritation. Duret has shown that concussion is due to force transmitted through the cerebro-spinal fluid to more or less distant parts of the brain, but chiefly the fourth ventricle. The intrarachnoidian extravasation and effusion into the pia-mater are due to distension of the perivascular sheaths of vessels, whereby the arterioles are directly compressed, and the capillaries through the medium of the brain substance; when the pressure is removed, from the violence ceasing, the vessels burst from unopposed tension of their contents. From contraction of the arteries the venous tension at once falls, producing cerebral anæmia, and thus loss of consciousness. The spasmodic arterial contraction is followed by inflammatory dilatation from the irritation caused by the numerous hæmorrhagic lesions.

Symptoms vary with the degree of injury. Three forms are recognised. 1. *Slight concussion.* In these cases there

are momentary loss of consciousness and recollection, pallor of the countenance, return to consciousness, swimming in the head, and nausea. Depression of the circulation, with a feeble and rapid pulse.

2. *Complete insensibility.* When more severe, the patient is quite insensible, the prostration is profound, the surface of the body pale and cold, limbs flaccid, circulation is feeble (the pulse being soft, small, fluttering, and intermittent); respiration is slow and shallow, breath is cold, the pupils are contracted, but sometimes dilated, or one may be contracted and the other dilated. The sphincters are relaxed, urine and faeces being voided involuntarily; there is loss of muscular power, and deglutition is impossible. This state may last from a few minutes to hours or days, but as reaction ensues he becomes warmer, vomits (often a favourable sign, as it shows the vagus is recovering its function). There is increased action of the heart and respiratory organs. Pirrie points out a symptom in the stage of reaction, which he considers pathognomonic of concussion—namely, very great acceleration of the pulse when the patient rises up or makes exertion of any kind. Sometimes, when the pulse is not more than 70 to 80 in the recumbent position, it is so greatly accelerated by the patient's rising as to reach from 120 to 130 in a minute. 3. *Complete insensibility, with an imperceptible pulse.* In this variety the prostration is persistent, the patient never passing out of a state of collapse, and dying in this condition.

Terminations.—1. Complete recovery. 2. Intracranial hæmorrhage. 3. Excitability of the brain may be left. 4. Loss of some of the faculties, as amnesia, aphasia, agraphia, deafness, etc. 5. Inflammation of the brain. 6. Compression. 7. Insanity, or epilepsy.

Compression may arise: 1. From depressed bone; 2. Foreign bodies; 3. Extravasation of blood; 4. Formation of pus within the skull; 5. Tumours.

Symptoms.—1. *Alteration of sensibility and motion.* The patient lies in a state of coma or complete insensibility, quite unconscious of what is passing round him, nor being aroused when spoken to. There is inability to swallow; countenance is pale and expressionless; eyes are insensible to the light, one or both pupils being widely dilated, the eyelids

are closed; temporary loss of power in the voluntary muscles. Hemiplegia often occurs on the side opposite the seat of injury, and the mouth is drawn over to the sound side. Sphincter ani is paralysed, so that the faeces are passed involuntarily, or the bowels may be confined from torpor of the muscular coat of the intestines. Retention or incontinence of urine, according to whether the sphincter is paralysed or not. 2. *Alteration of respiration.* The breathing is slow and laboured (ten, eight, or six respirations per minute), stertorous, owing to paralysis of the soft palate, and in bad cases the air puffs out the cheeks and lips and raises the latter in expiration with a peculiar whiffing or blowing sound. This is an ominous symptom. 3. *Alteration of the circulation and temperature.* Pulse is slow and full (70, 40, 30, or 20 per minute). The temperature is maintained, or falls only slightly, unlike concussion.

Consequences.—Inflammation of the brain and its membranes. Occasionally a person may remain in a state of compression for months, and yet recover on removal of the cause; but, as a rule, death ensues if speedy relief be not given.

Irritation (Erichsen).—The patient lies on his side and all the joints are flexed; he constantly tosses himself about on the bed. The eyelids are firmly closed, and the surface cold and pale, there being no heat of the head. Pulse is small and slow, and the sphincters unaffected. The patient is unconscious, or rather semi-conscious, like a person partially intoxicated; if roused, he shows irritability of temper and obtuseness of intellect, grinding his teeth, frowning, turning away, and swearing. Respiration is easy, without stertor. Pupils are contracted, and marked delirium may be present. In a case where these symptoms were, after an interval of seven days from the injury, well marked, the patient had received a blow on the head from a slight fall, post mortem the anterior lobes were severely lacerated, and on the left side a large abscess cavity was found. Irritation usually accompanies laceration and contusion of the brain substance, and, together with the above symptoms, hemiplegia, paralysis, tremors, convulsions, rigidity and spasmodic movements of the face and lip may be present. Irritative cortical motor lesions may

cause epileptiform convulsions, beginning with a motor aura, either general, confined to one half the body, or to a single group of muscles. If the lesion be in the motor zone, paralysis of the affected muscles is prone to occur. The patient may begin slowly to recover, but some brain mischief may remain permanently. In other cases the patient dies from secondary effusion, or inflammatory softening invading the adjacent cerebral structures. The symptoms may alternately increase and diminish, prognosticating at one time death, and then recovery.

TABLE OF PRINCIPAL SYMPTOMS IN (PIRIE)

CONCUSSION.	COMPRESSION.	CEREBRAL IRRITATION.
1. Mental operations entirely suspended.	Mental operations entirely suspended.	Mental operations not suspended, but quiescent when not interfered with. Temper irritable when interfered with.
2. Functions of organs of sense suspended.	Functions of organs suspended.	Organs of sense not suspended.
3. Sensation and co-ordination of movements suspended, movements automatic.	Sensation and motion entirely suspended. No movements at all.	Sensation not lost. Flexors firmly contracted. Patient lies on the side.
4. Pupils natural but sensible to light.	Pupils dilated but insensible to light.	Eyelids shut and compressed. Pupils generally contracted.
5. Respiration silent, feeble, shallow, often slight sighing.	Respirations slow, full, laboured, stertorous. Puffing of cheeks and tremulation of lips.	Respiration <i>not</i> affected.
6. Pulse weak, small, frequent, fluttering.	Pulse slow, full, and laboured.	Pulse moderately feeble. Natural in frequency.
7. No power of swallowing, vomiting in favourable cases.	No power of swallowing, sometimes vomiting. Bowels constipated.	Swallowing, etc., unaffected.
8. Sphincters relaxed.	Sphincters relaxed.	Sphincters unaffected.
9. Surface of the body cold and blanched, frequent shivering.	Surface cold, livid, and swollen. Clammy sweats.	Surface of the body rather cold.
10. Patient cannot be roused.	Sometimes recovery to a slight extent soon after the injury.	Can be roused, but evinces great irritability.

Encephalitis and Meningitis.—Causes.—Wounds or erysipelas of the scalp. Contusion of bone. Contusion of brain substance. Concussion. Fracture. Intracranial hæmorrhage. Caries of the temporal bone. Inflammation of the middle ear. Pachymeningitis is the term applied to inflammation of the dura mater, lepto-meningitis to inflammation of the pia mater.

Pathology.—The arachnoid is thickened and opalescent. The hemispheres are covered with lymph. The arachnoid is reddened and its cavity filled with yellowish or greenish fibrinous or puriform exudation; the pia mater is also congested and covered with the same exudation. It is unusual for the inflammation to spread over the dura mater much beyond the area of the original

injury; but if any part of the arachnoid be affected, the inflammatory process extends all over this membrane. The cerebral substance on section presents a rosy appearance, and the ventricles are filled with inflammatory products. In some cases the inflammation is limited to the brain and pia mater, in others all the coverings are affected, starting from the dura mater and proceeding inwards. If inflammation start in the brain, there is generally no effusion in the arachnoid, but when dependent on disease of the bone it is the rule to find effusion in this situation.

Symptoms.—Acute cerebritis. If dependent on concussion it arises at an early period (within 48 hours), when produced by contusion of the brain substance from the fourth to the fifth day,

if an injury to the bone it appears in a few days to weeks. 1. *Stage of excitement.* Pain, headache, scalp is hot, pupils contracted, eyes wild and glistening, conjunctiva injected, intolerance of light and sound, sleeplessness, great restlessness, the face is flushed, carotids and temporals throb violently, pulse quick and hard, tongue furred, skin hot, bowels confined, urine scanty, food is vomited, delirium often of a furious character soon supervenes. Other and important symptoms sometimes present are engorged optic papilla, atrophy of the optic nerve. The temperature is elevated, particularly if taken in the rectum, which is most trustworthy; but meningitis may run its course with very low temperatures. The pulse at the beginning of meningitis, as observed by Richardson, may be peculiarly arhythmic; for instance, 80 beats may be counted in a minute, followed two or three minutes later by 120, and then returning to the ordinary rate. 2. *Stage of Collapse.* Twitching of muscles, convulsions, pulse becoming feeble and slow, rigors pointing to suppuration, squinting and dilatation of the pupil, impairment of vision, muttering delirium, paralysis, stertorous breathing, and coma.

Terminations.—Under appropriate treatment resolution may occur, but very often symptoms of compression set in, from the formation of inflammatory products within the cranium pressing on the brain substance. An insidious and chronic form is met with occurring after concussion, contusion, fracture, and other lesions; it is apt to be overlooked; its onset may take place from a few days to months after the injury. The patient may appear to have completely recovered after the accident; though, as a rule, some symptom, as headache or irritability, remains. The course of events is that the patient, having sustained some such accident as before mentioned, imagines himself to be quite well, and perhaps returns to his business. Soon irritability of temper, headache, capricious appetite, confined bowels, restless nights, frequent pulse, dizziness, etc., exhibit themselves. All this time mischief is progressing in the brain of an inflammatory character, and leading to the formation of pus in the brain substance or membranes, or a sudden delirium supervenes, followed by coma and death.

Intracranial Suppuration—1. *Subcranial.* The pus being lodged between the skull and the dura mater. It always occurs at the part struck, and is circumscribed, but may attain a large size. Any injury sufficiently severe to separate the dura mater from the bone, produce caries or necrosis of a portion of bone, or result in depressed fracture, may lead to it. The symptoms present themselves from a week to a fortnight after the lesion. 2. *Intrameningeal* in the cavity of the arachnoid or in the pia mater. This form may either appear on the side struck, or on the opposite aspect from “*contre-coup*,” and is always diffused, particularly affecting the superior, anterior, and lateral portions of the brain. The symptoms commonly develop from the eighth to the twenty-first day. 3. *Intracerebral* is usually collected into a circumscribed abscess, located either at the part struck, or more commonly at the opposite side, from *contre-coup*, or lodgment of a foreign body. The quantity is as a rule small. The cerebral tissue around is softened and disintegrated, or changed into a diffuent, pulpy mass. The symptoms generally arise about the twenty-fifth day, rarely before the fourteenth.

Symptoms.—Of the first variety, are those of Potts’ swelling. During an attack of cerebritis, rigors set in, and gradually increasing coma. A puffy or baggy swelling forms, which increases, becomes hotter, doughy, and fluctuates; should there be a wound, it ceases to discharge, and the pericranium separates from the bone, which appears dry, and is of a yellowish brown colour. There may be hemiplegia.—*Of cerebral abscess.* Mental hebetude, slow pulse, headache, paralysis, rigors, subnormal temperature, constipation, followed by compression.—*Of chronic cerebral abscess.* The symptoms of inflammation disappear for a longer or shorter time, usually from one to two months, but it may be for only a few days. I have seen one case in which the period of latency was eighteen months, and it has been upwards of three years. Local symptoms may be present, as aphasia, paresis, hemiplegia, and even convulsions. Occasionally headache, and attacks of nausea, vertigo, and slight feverishness or stupidity, disinclination for exertion, failure of mental powers. Sleeplessness, optical delusions,

and attacks of fright are sometimes present. In other cases, the patient is feverish, and has severe headache, and there may be violent delirium, followed by a comatose condition. In later stages, irritation, restlessness, illusions, violent delirium, with elevation of temperature; subsequently sleepiness, headache, slow pulse, dilated pupils, retinal congestion, low temperature, vomiting, coma, hemiplegia, and death. Griessinger has laid down the following formula in discriminating between diffused and local symptoms. The first may be present in all diseases of the brain, the latter point to a definite seat of disease; the diffuse symptoms relate rather to both hemispheres, the local symptoms more to one. Abscesses generally form either in the anterior or middle lobes of the brain.

Treatment. Of Concussion.—Keep the patient perfectly quiet in bed, and do not move him from the locality of the accident; brandy or ammonia should be injected into the rectum, or ether subcutaneously, hot-water bottles to the feet and sides of the body, or heated bricks wrapped in flannels, hot blankets, sinapisms to the epigastrium. In milder forms, place the patient in a horizontal position, raise the head slightly, remove or loosen tight clothing, wrap patient in blankets and apply hot-water bottles to the extremities between the thighs, or between the chest and arm. When the power of swallowing returns, give warm tea or coffee. The second stage, or reaction, requires confinement to the bed or house for at least three weeks; to prevent cerebritis, purging and a low diet, all stimulants being strictly avoided. If there be any headache or any premonitory symptoms of inflammation, strict confinement to bed, perfect quietude of mind and body, ice to the head, or Leiter's coil, leeches behind the ears or general bleeding, purgatives, and a low diet. Should the mental faculties remain impaired, blistering, cupping, setons through the nape of the neck, and mercurials are useful.

Of Cerebritis.—In the acute form keep the patient in bed in a darkened room, shave the head, and apply icebags or Leiter's coil. General bleeding, repeated as often as the pulse increases in force or frequency, followed by tr. aconiti in drop doses every half hour. Free purga-

tion by colocynth and calomel or croton oil, enema of turpentine 3j to gruel O j. Morphia by hypodermic injection at nighttime to ease the pain, or bromide of potassium in full doses. Small doses of calomel with opium should be regularly administered. Avoid stimulants, and feed on a milk diet. Ice and cold acidulated drinks to relieve thirst. In the chronic form the persevering use of calomel gr. ss (om. 4 h.). Counter-irritation to the shaven scalp by blistering fluid or croton oil. Seton through the nape of the neck. Complete rest. Strong liquid diet. The treatment must be continued for some time after all apparent symptoms have disappeared.

Of Cerebral Irritation.—Complete rest, mild purgation. Cold to the shaven scalp. Bromide and iodide of potassium.

Of Compression.—Keep the bowels open by a drop or two of croton oil mixed with a little compound jalap powder, and placed on the tongue with a little butter; or a turpentine enema. Attend to the bladder and draw the water off with a catheter. Perfect rest and ice to the head are the general measures to be used. Carefully examine for kidney disease, as in the presence of this, prognosis is most unfavourable.

Locally.—The cause of pressure must be moved. If the compression be due to depressed bone, elevate it or remove it. If it arise after concussion and appears to be due to hæmorrhage, trephine over the parietal bone, as you are likely to come on the seat of hæmorrhage. If the bleeding occur twenty or thirty hours after the accident, bleed freely from the arm to a state of syncope, as the extravasation probably proceeds from small vessels and strips the dura mater from the cranium. A subcutaneous injection of ergotin should also be given.

Of Laceration.—Apply cold, and check cerebral complications.

For Intracranial Suppuration.—In Potts' swelling incise the tumour and let out the pus; if the bone appear yellow and dry, trephine the central part and evacuate the matter underneath. If the dura mater be white, bulging, and do not pulsate, aspirate, and if pus be present, incise it. When the abscess is deep-seated, whether in the substance of the brain or the ventricles, the surgeon must not hesitate

in making a free incision through the superimposed cerebral tissues. Though desperate, this holds out the only hope of success.

For Pyæmia.—The usual treatment must be pursued.

Brain Surgery. Method of Operating on the Brain.—The following is a condensed account of a paper read by Victor Horsley, who has performed such admirable work in this field.

Preparation of the Patient.—The day before the operation the patient's head is shaved, and washed with soft soap and then ether. Next the position of the lesion is ascertained by measurement, and marked on the scalp, the head is then covered with lint soaked in a 1 to 20 solution of carbolic acid, oil silk and cotton wool, being thus thoroughly carbolicised for at least twelve hours before the operation. Finally, the patient has the usual purgative administered the evening before, followed by an enema on the morning of the operation.

Anæsthetic is important, and consists in the administration by hypodermic injection, of a quarter of a grain of morphia, after which chloroform is applied. The morphia is used: 1. Because less chloroform is required; 2. Because it causes well-marked contraction of the small arterioles of the brain, and thus prevents hæmorrhage.

Treatment of the Wound.—Carbolic spray, 1 in 20 carbolic lotion, and for the first few days at least dressings of carbolic gauze.

Line of Incision.—A semilunar flap is to be raised and thrown back. 1. The incision must be carried vertically to the bone, and all parts superficial to the periosteum raised with the flaps. 2. The curve must be a shallow one, to avoid cutting collateral vessels. 3. It must be so drawn as not to divide the main arterial trunks supplying that portion of the scalp. 4. The periosteum should be reflected by a crucial incision from an area corresponding to the first trephine hole, and subsequently as more bone is cut away.

Removal of the Bone.—A couple of trephine holes are made with a trephine two inches in diameter, at the opposite extremities of the area to be removed, then half cut through the sides of such area with a Hey's saw, and finally complete the division with powerful bone

forceps. Where it is possible to preserve the dura mater intact, the portions of bone removed should be preserved in warm antiseptic sponges, and at the end of the operation should be placed between the skin and dura mater, having previously been divided into small fragments after the manner indicated by Dr. Macewen.

Treatment of the Dura Mater.—The dura mater should be incised round four-fifths of the circumference of the area exposed at one-eighth inch distance from the edge of the bone, so as to render it possible to stitch the edges together afterwards. The dura mater is best opened first by incision with the scalpel and then by blunt-pointed curved scissors, great care being taken not to wound the meninges beneath. The main branches of the middle meningeal artery are best secured by a ligature, passed through the dura mater just outside its cut edge, and knotted before the vessel is divided.

Treatment of the Brain.—1. Notice if the brain bulge into the trephine hole or not. If bulging be present, intracranial tension exists, which, other things being equal, will indicate the presence of a tumour. 2. Notice the colour of the brain; a slight yellowish tinge and possibly lividity will indicate the existence of a tumour beneath the cortex in the corona radiata. 3. The condition of the vessels and perivascular lymphatics must be investigated, and particular note taken of any yellowish white patches on the walls of the latter, indicating old mischief. 4. Alterations in the density of the brain.

With regard to Hæmorrhage, Horsley points out: 1. That in the brain, as in the kidney, the vessels are directed perpendicularly to the surface. Every one who has had experience of operating on the kidney knows that a free incision of the knife into the organ is followed by profuse and, to some, alarming hæmorrhage, but that this bleeding will permanently cease if the wound be plugged for a few minutes by a sponge. With this fact in view, the brain should be treated in exactly the same way, at the same time obtaining a cleanly cut surface, most favourable to rapid union; 2. The injection of morphia will diminish bleeding; 3. Considering the terminal character of the cerebral arteries, where

possible every main vessel should be left intact, and as they run in the pia mater they can be raised from the brain and out of the sulci, so as to allow the subjacent brain to be removed while at the same time the vessel wall is but little damaged.

Incision of Brain.—The cuts in the cortex must be made exactly vertical to the surface, and directed into the corona radiata, in such a manner as to avoid damage of the fibres coming from that portion of the cortex and surrounding the seat of the operation. Care must be taken to leave, if possible, portions of each centre, so that the representation of movements of any particular joint may never be totally destroyed, or permanent paralysis will result on the opposite side to the centre.

Result of Removal.—When a portion of brain is removed, the floor of the pit, that is the corona radiata, bulges almost to a level with the surrounding cortex. In addition, the cut edges become slightly everted, and if less brain than bone be removed there is a tendency to hernia cerebri. The large semilunar flap, however, offers plenty of resistance to the upward pushing brain.

Closure of the Wound.—All oozing, etc., having been made to cease by gentle pressure with a soft sponge, the flap is

laid down and secured with medium silk sutures at a distance of one centimetre, and between these horse-hairs.

Drainage.—A drainage tube is put in the most dependent part of the wound, and *allowed to remain for four and twenty hours*, but no longer, or the success of the operation will be jeopardised. On the drainage tube being removed, firm but gentle pressure is made over the centre of the flap, the wound being carefully dressed. On the third day, if exudation have accumulated in the cavity, and the patient complain of pain and throbbing in the wound, which when exposed is found distended in the centre, whilst the periphery is united, the track of the drainage tube must be opened with a probe. It is to be remembered that tension is of value in reducing the hernial protrusion, compelling the lymphatics of the brain meninges to absorb the fluid, so admitting of rapid union of the whole skin wound, and finally acting as a scaffold for the building up of a normal connective tissue in the parts. At the end of a week the wound may be lightly covered with a little powdered boracic acid, cotton wool, and collodion. It will always be found that the scalp tends to fall in a little at the seat of operation.

CHAPTER XXV.

PLASTIC SURGERY OF THE FACE.

PLASTIC operations are performed to remedy disfigurement and to restore the use of a part. These operations depend on two principles: 1. The mobility of the skin and subjacent tissues, permitting their transference from one place to another; 2. The ability of the skin to unite in a new position, and become incorporated with the surrounding integument. The means adopted are classed by Denucé in the six following groups: (a) Traction; (b) Relaxation, by facilitating traction and diminishing the size of the gap; (c) Subcutaneous detachment, or freeing the integument and cellular tissue from the subjacent parts, by the use of the knife; (d) Excision of triangular portions of tissue

from the circumference of the defect, facilitating the gliding of its margins towards each other or altering its shape; (e) Incisions of two kinds; *lateral or liberating*, parallel to, or at a distance from the defect, or at right angles to its margin; *the direct*, usually straight but occasionally curved V- or W-shaped; (f) Transposition or transplantation of a flap to fit the defect. These six categories may be broadly divided into two classes: 1. Gliding; 2. Transplantation. The surgeon must always try for primary union, and the patient be carefully prepared beforehand, any constitutional dyscrasia being carefully removed, especially syphilis. The tissues concerned must be in a healthy state. The

operation, if complicated, should be divided into several sittings, and all tissues operated on not absolutely necessary to be removed must be carefully saved. The operative steps are: 1. Refreshing the edges of the gap with the knife or scissors, care being taken to thoroughly remove all skin covering the margins or surface; 2. Cutting the flap; this must be adapted to the size of the gap, but be from a quarter to one-third larger than the latter to allow of shrinking from the natural elasticity of the skin; 3. Accurate adjustment of the contiguous surfaces and margins of the flap and gap, by fine sutures, either interrupted, twisted, or quilled; 4. If necessary, in addition use deep sutures to relax tension; 5. All blood clot or foreign substances must be carefully excluded; 6. If primary union do not occur, skin grafting should be employed; 7. The part should be immediately covered with oil silk, and outside this iodoform cotton wool, collodion or styptic colloid is used to fix dressings in place, and not plaster.

Rhinoplasty is the restoration of the nose when lost from injury or disease, or unsightly from congenital deformity. When this operation is performed for deformity resulting from specific disease, an interval of six months must have elapsed since the disappearance of the last symptoms of the affection.

1. *Superficial defect* not involving the bones or septum. If the gap be small and do not involve the free border of the ala, square lateral flaps are made by horizontal incisions above, below, and each side of the deficient part, and drawn together after being dissected from the subjacent tissue. If one ala be deficient, suitable oblique or vertical flaps are taken from the cheek and applied to the gap previously pared, and fixed here by fine sutures. In some cases the flap may be obtained from the opposite side of the nose. To restore the columna, a flap is taken from the upper lip, which is cut through for its whole length from above downwards on each side of the middle line, so as to form a vertical flap, quarter of an inch broad. This is turned directly upwards without twisting the pedicle, the mucous membrane thus forming the outer surface; it is then stitched to the prepared apex by fine silver sutures, or the hare-

lip pin and twisted suture. The wound of the upper lip is treated as a harelip. The mucous membrane soon assumes the appearance of normal skin.

2. *Entire nose.* (a) *Indian or Frontal Operation.*—(1st Step.) A pattern is made of the flap by fitting on the nose a piece of moulding wax or gutta percha. The flap is made one-third larger than the pattern. The pattern being applied to the forehead immediately above the nose, the boundaries of the flap which exceeds the model a quarter of an inch in every direction, are marked out with tincture of iodine. The flap is best taken obliquely from the right side of the forehead, and the incision is prolonged lower on the right than on the left side. It is to be raised, including all the tissues down to, but not touching the periosteum. The hæmorrhage from this large wound is now arrested.—(2nd Step.) The edges of the defect are pared, the knife being carried obliquely from without inwards, so as to form a sloping wound.—(3rd Step.) The flap attached to its pedicle, is brought round so as to cover the gap, and carefully applied to the edges previously prepared for its reception, and fixed with silk sutures. The pedicle must be left as lax as possible to maintain the vitality of the flap. The nostrils are filled by plugs of oiled lint, and the lower part of the frontal wound closed by harelip pins and twisted sutures. After the flap has united and circulation is established in it, the pedicle is divided and a columna formed from the upper lip. The new nose must be supported from beneath for some months, by small gutta-percha or gum-elastic tubes, or Langenbeck's plugs.

(b) *Italian or Tagliacozzian Method* is now rarely adopted. A piece of skin of suitable size is marked out over the left biceps, the apex being directed towards the shoulder, by two nearly parallel incisions. The intermediate piece of skin is raised from the subcutaneous cellular tissue, but left adherent at both ends, and a piece of oiled silk passed under it and kept there until suppuration is established. The upper end is then divided, and the flap dressed carefully for a fortnight. Its edges, and those of the old nose, are then carefully freshened and fastened together by sutures, the arm being bound fast to the

head. At the end of another fortnight the lower end of the flap is cut loose from the arm, and its edges trimmed to the proper shape.

Cheiloplasty, or restoration of the lip, is usually performed to replace loss of substance after removal of an epithelioma of the the lower lip.

(a) *Serre's Method*.—After the growth has been removed by the V-shaped incision, a horizontal cut on each side is carried outwards from the angle of the mouth, including the whole thickness of the cheek, for the first two-thirds, but dividing the mucous membrane at a higher level than the skin. The lower lip is then dissected away from the jaw, at the inner side of the mouth, until the edges of the V can be brought together without tension. The gap is then united by sutures, and the lip formed from the lower part of the horizontal cuts. The mucous membrane and skin are stitched together along the edge of the new lip. A piece of oiled lint must be kept between the inside of the lip and gum to prevent union.

(b) *Dieffenbach's Method* consists in adding at the end of each horizontal incision, a vertical one, thus marking out two square flaps, which are united in the middle line, the gaps left in the cheeks being allowed to granulate.

(c) *Buchanan's Method*.—The tumour is removed by a V incision, and the incision extended downwards and outwards towards the chin for an inch, and then curved upwards and outwards parallel to the lower border of the lip. These flaps are dissected up and united at the middle line. The mucous membrane and skin are stretched together along the upper edge, and the gaps left below allowed to granulate. Malgaigne made square lateral flaps, and Sédillot square flaps at a right angle with the line of the mouth. The foregoing will serve as examples, for each case of cheiloplasty presents great variety in detail, according to the gap which has to be filled, and the sources from which skin can be secured, and must thus be treated on its own merits.

Contraction of the Mouth is best treated by splitting the tissues at the side of the contraction, horizontally, dividing the lips mid-way between the cutaneous and mucous surfaces, upwards and downwards for a short distance, with

a sharp pointed bistoury introduced flatwise. The inner flap, which consists of mucous membrane, is divided into two longitudinally, and a V-shaped piece is cut from the skin flap. The mucous membrane is stitched by fine carbolised silk sutures. Mason introduced a wire thread at a suitable distance from the angle of the mouth, and after the opening had healed, forming a fistula, the parts were divided between this and the mouth.

Harelip consists in a congenital fissure of the lip, due to arrest of development during the early weeks of intra-uterine life, prior to the fourth month. The simplest form is *Single Harelip*, consisting of a single cleft of the upper lip to one side of the middle line, at the junction of the foetal intermaxillary bones and the superior maxilla, and between the outer incision and canine teeth. It is most common on the left side and in the male sex. The inner side of the fissure is rounded, and the outer flat and oblique. It generally extends from the nostril to the border of the lip. On the affected side the nostril is expanded and the nose flattened at the side. A mesial fissure is extremely rare.

In *Double Harelip* there are two fissures, one on each side; between these the intermaxillary portion projects, covered by an intermediary portion of the lip. The fissures are not usually of the same size or shape, one being deeper than the other, and may extend into the nostril. The central part varies much in size, shape, and position; it contains the incisor teeth, and is often situated at right angles with the jaw; it may be attached altogether to the nose. Other congenital malformations often accompany harelip, the most common of which are cleft palate, club-foot, spina bifida, and scrotal hernia.

Treatment consists in a plastic operation, which should be performed from six weeks to three months after birth. Sayre however recommends that the operation should be performed at the time of birth.

Operations for Single Harelip.—Instruments required: 1. Scalpel, bistoury, or cataract knife. 2. Artery and torsion forceps. 3. Harelippins. 4. Wire nippers. 5. Prepared silk. 6. Silver sutures. 7. Strapping. 8. Scissors. 9. Collodion. 10. Hainsby's cheek compressor. 11. Sponges.

12. Large towel to envelope the child. 13. Pressure forceps. 14. Chloroform. The child is anæsthetised, its arms secured to the side by a towel, and its head firmly held by an assistant. The coronary arteries must be controlled by an assistant seizing the whole thickness of the lip between the finger and thumb, or a compression forceps may be applied.—(1st Step.) *Detach the lip freely from the gum on each side of the fissure, and the ala nasi, if necessary, from the bone.* This procedure is of the utmost importance.—(2nd Step.) The operator then seizes the extreme angle of each of the sides with artery forceps, or preferably a ligature may be previously passed through the angle of each of the sides, and the two ends tied so as to form a loop six inches long, enabling the surgeon, or an assistant, to make traction in any direction. The upper angle is then transfixed with a sharp narrow straight bistoury or Beer's cataract knife, and the edges pared from above downwards, first on one side and then on the other. The surfaces should be made straight, or slightly concave, and the upper angle must be well cut out. The great fault with beginners is that too little is removed. Any bleeding vessel is twisted.—(3rd Step.) Approximate the edges and close the wound with two or more silver sutures, inserted deeply, close to the membrane, one at the nasal angle and the other near the free edge. A silk suture should be passed through the mucous membrane, inside the lip. Collodion may be brushed along the line of the wound. The sutures may remain for six or seven days. A strip of plaster is carried from cheek to cheek, to relieve any tension on the stitches, or Hainsby's spring cheek compressor may be used for the same purpose, or a long strong pin passed through lip half an inch from the wound. Some surgeons prefer harelip pins and a twisted sutures.

Operation by Double Flap (Clémot or Malgaigne) is preferable, as no depression is left at the free border of the lip. The preliminary steps are the same as in the preceding operation; but the incisions used in paring the edges stop short of the margin of the lip, leaving two flaps attached at their lower ends to the lip. These are then turned down so that their raw surfaces face each other, and a suture passed through their free ends.

If, when the parts have healed, the flaps be found to be redundant, they are easily lessened by the scissors.

Operation for Incomplete Harelip (Nélaton).—In this operation, which can only be performed when the fissure does not extend to the nose, the flaps are left attached at the upper angle, as well as the free edge of the lip; then pulled down, so as to bring the raw surfaces together, and make a diamond-shaped wound, which is brought together by sutures.

Operation by Single Flap.—A flap is made on one side only, usually the shorter one, and left attached to the free border of the lip. The other side is then freshened by removing a strip of skin and mucous membrane, and the flap fastened to the freshened surface.

Giraldé's Operation is only used when the fissure extends into the nostril. The flap on the short side is left attached below. That on the long side is left attached at its upper end. A third incision is made outwards from the edge of the nostril, at the upper end of the incision for the first flap; this is to render this part of the lip more movable. The second flap is turned upwards towards the nostril, the first brought down in its place, and the raw surfaces joined by sutures.

Operations for Double Harelip.—Both fissures, as a general rule, should be closed at one sitting.

Operation for Simple Double Harelip, where there is no bony deformity, consists in making flaps as in the operation for single harelip with double flaps, on each side, then paring the intermediary portion so that it forms a triangle with the apex downwards. The flaps are brought together below the central portion. The topmost suture passes through one flap, through the base of the triangle, and out through the other flap; the second through both flaps and the apex of the triangle, and the third unites the flaps to form the prolabium below the triangular part.

Operation for Complicated Harelip.—The chief point to be considered is the manner in which the intermaxillary part shall be dealt with. This should always be retained if possible. When only slightly projecting it may be pressed back by slight pressure from a spring truss worn for a few weeks. If large and projecting, it should be seized with

strong forceps, and bent or broken to a proper position, a proceeding which is aided by previous division with a strong knife. The bone is kept in place by a strip of adhesive plaster, and soon becomes fixed. The best instrument to use is a Butcher's pliers, the bent blade of the instrument being applied on the anterior surface near the further nostril. When connected with the septum nasi, a triangular piece with the base downwards may be cut out of this, and the projection pressed back. There is usually sharp hæmorrhage, which is checked by pressure with the finger, a heated probe, or a compress and bandage. If attached to

the columna of the nose, Erichsen advises the following operation: 1. The triangular flap of skin covering the intermaxillary portion is to be dissected up as thickly as possible; 2. The intermaxillary process is then cut away at its root, which is small and pedunculated, with a pair of scissors; 3. The edges of the lateral fissure are then pared in the usual way; 4. The free lower margins of the pared edges are brought together by one harelip pin and twisted suture; 5. The leaf-shaped flap is then laid down in the triangular hollow left above the pin, and retained there by one or two points of silver suture on each side.

CHAPTER XXVI.

INJURIES AND DISEASES OF THE SPINE AND ADJACENT PARTS.

Wounds of the Back are treated on ordinary principles, but if important arteries in the posterior cervical region are involved, Lidell gives the following rules:

"1. Diagnosis as to what vessel is injured must be made by exploring the wound itself with a finger, ascertaining by the tactile sense the point whence the blood issues, and determining by the same means its anatomical relations.

2. The bleeding vessel must be brought into view by enlarging the wound without delay; and it must then be tied at the place of injury with two ligatures, one of them being applied on each side of the aperture in its walls, or to each end of the artery if it be severed. The artery should be divided midway between the two ligatures, for the purpose of allowing its ends to retract and contract, in all cases where it has not been severed by the original wound.

3. Where one of the vertebral arteries is wounded in that part of its course which lies in the canal formed by the foramina in the transverse processes of the six upper cervical vertebræ, the hæmorrhage must be restrained by plugging the injured artery with one or more cones, made out of fresh animal tendons (readily procurable at a butcher's), having the diameter of a pea, and having been smeared with a strong solution of ferric perchloride. Both ends of the vessel

must be plugged, as in this situation ligatures cannot be applied.

4. These wounds should be thoroughly cleaned with antiseptic lotions. Their lips should be drawn together and held in apposition by means of interrupted sutures. Should the occurrence of deep-seated suppuration be probable, adequate drainage tubes should be inserted. Antiseptic dressings should be applied externally.

5. Inasmuch as there is great flexibility in the neck, fixing the head by means of a stiff collar, so as to secure quietude in the cervical muscles, will considerably expedite the recovery, diminish the liability to secondary hæmorrhage, and it should therefore always be employed in these cases."

Concussion and Contusion of the Spinal Cord, from direct violence, occur as the result of blows, falls, or railway accidents.

Symptoms vary according to the part struck and the severity of the blow. Death may immediately ensue or within a short time, particularly when the upper cervical region is the situation affected. In other cases the injury is shown by the immediate onset of more or less complete paralysis of those regions placed below the seat of injury, with loss of sensibility, voluntary motion, and reflex action; the patient feels sick, looks pale, and dyspnœa with involun-

tary evacuation of the feces and retention of urine are present. Hyperæsthesia may develop later on if reaction set in. Recovery may occur, though the surgeon must give a very cautious prognosis after any such injury. In some cases the paralysis disappears, but the mind remains affected for some days; in others there is excessive irritability of the bladder with an incessant desire to pass water, the latter being increased in quantity. Minute extravasations of blood into the substance of the cord are generally present, or more or less contusion.

Terminations.—Recovery, which may be perfect or associated with impairment of function in some special organ or limb. Partial paralysis. Neuralgia. Muscular twitches. Defective speech. Atrophy of muscles. Loss of sexual power. Paralysis of sphincters. In a third group hæmorrhage takes place into the spinal cord, or a meningitis or myelitis is occasioned. Degeneration of the cord, and disease of the mucous membrane of the bladder, often lead to a fatal result.

Treatment.—Complete and absolute rest on a prone couch or water bed. Chloral and bromide of potassium. Dry cupping over the spine. If hyperæsthesia be present opium and belladonna. When inflammation is suspected, ice to the spine in a bag, and counter-irritation by mustard poultices, iodine liniment, etc. Catheterisation and enemata, to relieve the bladder and rectum.

Sprains. Causes.—Falls. Wrenches or twists from railway accidents or other injuries. Gymnastic contortions. Heavy weight falling on the back when the lower limbs or pelvis are fixed. Lifting heavy weight: one of the most serious cases I have seen occurred whilst a man was endeavouring to raise a heavy ladder against a wall. These lesions may be divided into three classes: 1. Simple, without injury to the cord; 2. With immediate injury to the cord or membranes; 3. With injury to the cord or membranes occurring subsequently at a greater or less interval. The most common situations are the cervical or lumbar regions.

Symptoms of Simple Sprain.—Pain, rigidity of spine, feeling of soreness and bruising. The pain is always increased

by pressure, motion, and change of posture. There are, as a rule, febrile symptoms and effusion. A good deal of swelling occasionally occurs, and after some days the skin may be discoloured. When the loins are affected hæmaturia is sometimes met with; this may be followed by nephritis or renal calculus. Sprains of the spine are always dangerous and serious accidents; death may result at once from simultaneous injury to the cord, deep-seated abscesses may form, or inflammation of the cord or its membranes may ensue either directly, or slowly, resulting in the course of some months in paralysis.

Treatment.—Absolute rest in bed for at least ten days, during which time the patient must be carefully watched for symptoms of injury to the cord or membranes. Ice. Calomel with pulv. ipecac. co. Light diet. Afterwards perchloride of mercury, blisters and massage. If the ligaments be stretched, a plaster of plaster of Paris jacket or gutta-percha support. Now and then malignant disease or disease of the vertebræ follow a wrench.

Hæmorrhage into the Spinal Canal.

Causes.—Concussion, wrenches, sprains, blows, falls, railway accidents, etc.

Situations.—1. Outside the dura mater in the meshes of the cellular tissue lining the vertebral canal (extrameningeal). 2. In the cavity of the arachnoid (rare). 3. Beneath the arachnoid into the subarachnoid cellular tissue (very rare). 4. Into the substance of the cord, especially the grey matter. It may result from very trivial injuries.

Symptoms rapidly follow the accident if the bleeding be meningeal, and in this case are mainly those of irritation, as pain, hyperæsthesia, spasm, tremor, spasmodic contraction of muscles, convulsions, and if there be much blood, effused paralysis of voluntary motion, commencing a few hours after the injury, in the parts below the seat of the effusion, and gradually spreading upwards. If the hæmorrhage be into the substance of the cord, almost instantaneous paralysis of motion and sensation, urinary troubles, bed sores, etc.

Treatment.—Rest in bed. Icebags to spine, or Leiter's coils. Leeches to the spine. Ergot and acetate of lead internally. When the bleeding has ceased, iodido of potassium.

Spinal Meningitis. Causes.—Blows on the back, falls, wound, wrenches, fracture, disease of vertebræ, bed sores, contusion of the spinal nerves in their sheaths as the former leave the intervertebral foramina. Acute meningitis generally commences within forty-eight hours from the injury, and starts in the pia mater.

Symptoms.—1. Deep-seated pain, coming on in paroxysms when the patient moves, felt most acutely at the seat of inflammation, and not increased by pressure. 2. Shooting pains in the limbs and trunk. 3. Rigidity of the spine and limbs resulting in opisthotonos, or an arched inflexible condition of the vertebral column. Painful spasms of limbs, with involuntary startings and jerks. 4. Hyperæsthesia. 5. Emaciation. 6. Breathing is hurried and embarrassed, pulse small and frequent, eyes intolerant of light. 7. Bowels are confined and bladder paralysed. 8. Later on, muscular weakness. If the cervical spine be affected the membranes of the brain may be also involved. Death generally ensues from exhaustion or asphyxia, being preceded by paralysis, delirium, coma, and convulsions.

Pathology.—The pia mater is vascular, infiltrated and thickened. The surface covered with exudation. Arachnoid inflamed. Sub-arachnoid space filled with effusion, which is often purulent. Dura mater inflamed.

Spinal Myelitis. Causes.—Injuries, as fractures, contusions, wrenches, concussion, wounds, caries of the spine, after meningitis. In a large proportion of cases the disease is propagated from without inwards, and does not originate in the spinal marrow. This is the case after violent wrenches, contusion, twisting or sprain of the spinal column, its ligaments, or joints, a slow insidious form of inflammation beginning in the sheaths of the nerves, periosteum, or connective tissue, creeps along until it reaches the membranes, and finally the cord, leading to progressive paralysis so terrible in its results.

Symptoms.—1. Slight pain over the spine, not increased on pressure or movement. 2. Motor paralysis, commencing at a short or longer interval. 3. Disturbances of sensation, as tingling, formication, hyperæsthesia or anæsthesia. 4. Loss of power over the bladder and

rectum with irritability of the bladder. 5. Priapism. 6. Disturbances of reflex action, which may be at first increased, with augmented patellar reflex and ankle clonus, later on diminished, and finally lost. 7. Bed sores. 8. Coldness of the paralysed parts. 9. Modification of electric excitability similar to that met with in wounds of nerves (*q.v.*).

Treatment.—Rest on a water bed, leeches, dry cupping, icebag to spine, blisters, ergot in large doses, belladonna, aconite, and perchloride of mercury. Later on warm salt-water baths, constant current to spine, and faradic to muscles.

Chronic Spinal Meningo-Myelitis. Causes.—It may follow acute attacks, railway accidents, and direct or indirect violence, often of a trivial character.

Symptoms are often insidious and occult. Pain in the back and limbs. Spasmodic movements and cramps in the legs. Sudden startings. Painful contraction and rigidity of the limbs, which become strongly flexed or rigidly extended; these may be intermittent or permanent. Alteration of sensibility. Paralysis, commencing insidiously and advancing gradually, with fluctuations of improvement. Little by little the power over the leg is diminished, the limb is dragged whilst walking, finally the ability to move is lost and patient is unable to stand, although he may still be able to move the limbs when in bed. Sphincters may be affected. Reflex movement increased at first, then diminished or abolished. According to the progress of the disease the electric contractility may be increased or diminished.

Treatment.—Dry cupping, blisters, perchloride of mercury, iodide of potassium, belladonna, ergot, warm salt-water baths, massage, constant current to the spine, induced to the muscles, tonics, fresh air, nutritious diet.

Concussion from Indirect Violence.—This subject is most ably and lucidly treated by Erichsen in his work on concussion of the spine, and it is to him we owe the chief part of our knowledge. He writes: "There is a class of cases of an extremely insidious and protracted character, in which the patient has received no blow or injury upon the head or spine, but the whole system has had a severe shake or shock, in consequence of which disease is developed in the spinal cord. These cases are more frequent in

railway than in other injuries; but they occasionally occur in consequence of ordinary accidents. One of the most remarkable circumstances connected with injuries of the spinal cord is the disproportion between the accident and the mischief produced thereby. Not only do most serious, progressive, and persistent symptoms of the spinal cord often develop themselves after apparently slight injuries, but frequently when there is no sign whatever of external lesion. . . . How these jars, shakes, shocks, or contusions of the spinal cord directly influence its action I cannot say with certainty. When a magnet is struck a heavy blow with a hammer the magnetic force is jarred, shaken, or concussed out of the iron. So if the spine be badly jarred, shaken, or concussed by a blow or shock of any kind communicated to the body, we find that the nervous force is to a certain extent shaken out of the man, that he has in some way lost nervous power."

Morbid Anatomy.—If death ensue early, no lesion of the cord may be discovered; in other cases hæmorrhages of the substance of the cord or its meninges are present. After a fatal result, at a later period the cord shows the appearances of meningo-myelitis.

Symptoms.—These injuries may be divided into three classes. 1. Immediate onset of severe symptoms at the time of injury, followed by recovery in a brief period. In this division, in addition to concussion, there has probably been hæmorrhage. There will be paralysis of motion, sensation only slightly affected, urinary organs or rectum not impaired. 2. Immediate onset of severe symptoms, followed by illness extending over a long period (often years), but ending in recovery. The symptoms are similar to the preceding group, but chronic. 3. Symptoms supervene at a greater or less interval after the injury, and gradually increase in severity. Recovery seldom occurs. Erichsen writes: "Most commonly, after the first and immediate effects of the accident have passed off, there is a period of comparative ease and of remission of symptoms, during which the patient imagines he will speedily regain his health and strength. . . . After a lapse of several months—from three to six—the patient will find that he is slowly but steadily becoming worse.

The countenance is usually pallid, livid, and has a peculiar careworn expression, the patient looking much older than he really is, or than he did before the accident." The thoughts are confused, attention cannot be concentrated, business aptitude lost, temper changed for the worse. Sleep is disturbed, restless, and broken. Head usually of a normal temperature, but may be hot, with feelings of pain, tension, weight, throbbing, giddiness, noises in the ear, etc. Attitude is stiff and unbending; movements of the head and trunk performed with pain and difficulty; gait is hesitating and straddling, and the patient is apt to lay hold of surrounding objects. The back is sensitive at one or two points. There is increasing weakness of the extremities, especially the legs, and most marked in the extensor muscles. Corded abdomen; modifications of sensibility, which in the early stages is often exalted, afterwards impaired. Coldness of extremities. Loss of weight, the muscles soft and wasted, in advanced cases may be rigid and contracted. The bladder is weak and irritable, but retention is uncommon, and the urine is not ammoniacal or offensive. Sexual powers much diminished. Sphincter ani not paralysed. *Pulse slow at first and feeble, afterwards quick.* Failure of power in the limbs is variable both in extent and degree; both arms, both legs, or a leg or arm may be paralysed, and in some cases a single group of muscles only is attacked.

Special Senses—Eye. The symptoms observed are asthenopia, or weakness of the sight; amblyopia, or paresis of the optic nerve or retina; loss or failure of the power of accommodation; irritability of the eye and photophobia. Taste and smell are but rarely affected; hearing may be over-sensitive or blunted; sense of touch is impaired; speech is rarely affected.

Diagnosis is made out by a consideration of all the symptoms. The degree and extent of paralysis is ascertained by the application of electricity. If the lesion of the nervous system be situated in the brain, or limited to the posterior or lateral columns of the cord, the electric reactions will be normal; but if the anterior horns of grey matter, or the trunk of a motor nerve be implicated, the electric test is invaluable, as it is not under the patient's control, and the evi-

dence afforded by it can be implicitly trusted. Examined electrically, the response to faradaic currents is found to be diminished or entirely absent, whether the reophores be applied directly to the muscle, or made to excite it indirectly by means of its nerve. If a galvanic current be applied *directly* to the muscle, and slowly made, and broken, it will contract even more than in health, but when passed *through the nerve* there is no result. Such a condition proves tissue change in the muscle, nerves, or anterior horns of grey matters. In all cases of supposed loss of motor power depending on spinal lesion, electricity can be as much relied on as the stethoscope in diseases of the chest, or thermometer in febrile diseases.

Treatment.—Rest in bed until paralytic symptoms have disappeared—the prone position is the best; absolute quiet; chloral and bromide of potassium, or hydrobromic acid; icebag to spine; dry cupping. In secondary effects, counter-irritation to the spine by blisters, or the actual cautery. Iodide of potassium and perchloride of mercury in small doses; calomel and extract of aconite are sometimes of service. When inflammatory symptoms have passed away, cod-liver oil, strychnine, and iron, warm salt-water baths or douches, the continuous current to the spine and the induced to the limbs; massage.

Time at which symptoms of Spinal Lesion appear after the infliction of the injury is important as a diagnostic point for localising the lesion. 1. When the symptoms occur instantaneously the injury is probably a central one, implicating the substance of the cord, and the cause, pressure from bone. 2. When the symptoms develop at an interval of several minutes or hours the lesion is intraspinal, and produced by pressure of blood from ruptured vessels, extrameningeal or intrameningeal; in the latter case the symptoms develop sooner than in the former. 3. When the symptoms are delayed from a week to one or two months they are due to inflammatory causes, as pressure from serum, lymph, or pus, the products of meningitis, myelitis, or both.

Dislocations of the Spine are usually conjoined with fracture of the articulating processes.

Dislocation of the Occiput from the

Atlas is of very rare occurrence, but is occasionally met with, the occiput being usually displaced forwards, though, as a rare event, this bone may move backwards. It is caused by violent bending of the head forwards or backwards. Spontaneous dislocation may occur when the ligaments are destroyed or weakened by disease.

Dislocation of the Atlas from the Axis is frequently met with, as a result of falls from a height on the vertex, side blows on the neck, lifting a child by the head, or as a sequence of disease. In most of these cases the odontoid process is broken. Death is usually instantaneous, from the atlas being displaced forwards, and the spinal cord compressed. Should this fatal event not occur, and the compression be only slight, perfect rest is imperative, with a small pillow under the nape of the neck.

Dislocations of the other Cervical Vertebrae.—The fourth is the most commonly luxated, the whole spine above the dislocated bone accompanying it; the displacement is forwards, and the intervertebral disc is torn completely through. If the cord be compressed, death generally ensues within seventy-two hours. Reduction should be attempted, under an anæsthetic, by extension (with rotation or pressure, as required).

Unilateral Dislocation of a cervical vertebra follows a sudden jerk or fall on the head.

Symptoms.—Stiffness and pain in the neck; the head and face are turned to the side opposite that in which the luxation is situated, and are fixed there immovably. The transverse processes on the displaced side occupy an abnormal position; tenseness of muscles on one side of the neck, and paralysis of one or both upper limbs.

Treatment.—The patient is placed on a table and anæsthetised. The surgeon grasps the head and makes gentle traction and rotation, the operator's knees being placed against the patient's shoulders; or counter-extension may be made by assistants, by means of a jack towel applied over the patient's shoulders.

Dislocation of Dorsal Vertebrae seldom occurs without fracture, but the twelfth dorsal is sometimes separated from the first lumbar.

Dislocation of Lumbar Vertebrae is never met with unless there be also a fracture.

For the general treatment of a patient with a dislocated spine, the reader is referred to Fractures.

Fractures of the Spine result either from direct violence, as a blow or crush, gunshot injury; or from indirect violence, as a sudden twist or bend of the trunk forwards; also as a sequence of falls from a height on the head, buttocks, or feet. In some cases this injury is associated with fracture of the sternum. In three-fifths of all cases dislocation is conjoined.

Symptoms vary according to the amount of displacement and accompanying injury to the spinal cord.—*Local.* Pain at the junction of the paralysed and non-paralysed parts, increased by touching or movement. The upper fragment moves downwards and forwards over the lower. The position of the spinous processes is an important sign, there being a sudden depression of the spinous processes of the upper fragment producing a marked angularity of the lower. The patient cannot stand upright or move the spine. In addition, there may be ecchymosis, swelling, and now and then crepitus.—*General.* These depend on the amount of injury the cord has sustained. If the spinous processes be alone implicated, the result is generally favourable; but if the laminae, and even if the “bodies” be fractured, though there may be no immediate symptoms, abscess and traumatic spinal meningitis or myelitis are apt to supervene, and in some cases hæmorrhage into the spinal canal. Should the injury be confined to one side, there will be hemiplegia of the same side, with loss of sensation on the other.

In fracture of a lumbar vertebra the symptoms depend on the situation of the lesion; if this be below the second lumbar vertebra where the cord terminates, there will be no paralysis unless the corda equina be much compressed, the patient is unable to stand upright, sit, or walk, but can move his legs when lying down, and the bladder and rectum are unaffected. When the two upper lumbar vertebrae are involved, the symptoms are paralysis of the legs (sometimes incomplete), paralysis of the sphincter ani, with retention of the feces, and if the bowels are moved by purgatives, involuntary passage of the feces, retention of urine from paralysis of the bladder followed by incontinence. The

urine becomes ammoniacal and eventually purulent owing to cystitis and pyelitis. The abdomen is distended from lack of tone of the muscles allowing the formation of flatus. Bed sores are prone to form. Reflex movements may be abolished if the grey matter be much injured, and the skin reflexes corresponding to the parts of the cord below the seat of the injury. Death ensues in about six weeks.

When a dorsal vertebrae is fractured and displaced, there are, besides the above symptoms, paralysis of the expiratory muscles. The respiration is diaphragmatic. Priapism is often present when the upper dorsal are affected. Retention of feces followed by incontinence. Death results from congestive pneumonia, pyelitis, cystitis, or bed sores, and occurs in from a fortnight to three weeks. Injuries to the cord in the upper dorsal or lower cervical may cause paralytic myosis in consequence of paralysis of the dilator fibres of the iris supplied by the sympathetic nerve. If a cervical vertebra be injured below the fourth, there will be in addition paralysis of the upper extremities, the inspiration will be entirely diaphragmatic, and death takes place as a rule from asphyxia within a week.

Should the fracture be above the origin of the phrenic nerve, death is almost instantaneous from asphyxia produced by paralysis of the diaphragm and the other respiratory muscles. In exceptional cases patients live for years even after fractures of the cervical and dorsal vertebrae.

Treatment.—Every care must be taken in moving the patient on a stretcher. The fracture should be adjusted by attending to the position, by extension and counter-extension with pressure on the fragments, or by continuous extension with weights when the spine is shortened. Should there be much pain, give opium or morphia in full doses. The patient should rest on a water bed, with his spine supported by sand bags, the bedclothes should be kept off the feet and legs by a cradle, and the legs should be supported with sand bags. The urine must be drawn off with a flexible catheter every six hours, and the bladder washed out with a weak warm solution of Condyl's fluid. If thought advisable the bladder may be tapped per rectum, or a perineal section be made. The bowels should be moved by castor

oil or turpentine enemata. Four or five leeches to the spine on the fourth or fifth day. If the dorsal region be affected, Sayre's plaster of Paris jacket applied in horizontal position is of great service in securing rest and immobility to the injured parts. Stimulants and a nourishing diet. In cases of fracture of the posterior arch alone, with depression of the spinous process, but without implication of the body, trephining the spine may be tried.

Treatment of bed sores arising from disordered innervation.—Brown Séquard recommends the alternate application of poultices of ice, and very warm bread or linseed. The ice is applied for ten minutes, and then the linseed for an hour, and these are repeated as often as necessary. Dr. Crussel of St. Petersburg uses galvanism as follows: A silver plate is cut the shape and size of the sore, and of the thickness of a sheet of paper; this is connected by copper or silver wire with a similar zinc plate. The silver plate is placed directly on the ulcer, the zinc on the neighbouring skin, with a piece of chamois leather kept moist with vinegar and water intervening. This plan is very successful.

To prevent bed sores constant cleanliness is needed. A water bed or well-stuffed mattress, on which the position of the patient should be constantly changed. The bed pan and urine bottle must be used, and a draw sheet is necessary. All exposed parts are to be washed with spirit of wine, in which powdered alum is dissolved, or lotio hydrarg. perchlor. (gr. ij to ʒj).

Fracture of the Odontoid Process is known by pain and stiffness in the neck, swelling in the region of the first and second vertebræ, and a protuberance in the pharynx. The patient carries his head supported by his two hands. If there be no displacement, the patient should rest in bed with a small firm pillow under the nape of the neck, and sand bags at each side of the head until the fracture is consolidated. If there be much displacement death is immediate.

Diseases of the Spine.

Spina Bifida consists in a congenital deficiency of the vertebral canal, one or more of the neural arches being separated or absent, in consequence of which the spinal membranes distended with

fluid, with or without the cord and its nerves, are protruded, forming an external tumour. The malformation is due to a primary defect in the development of the mesoblast, from which the structures enclosing the vertebral furrow are developed. Occasionally the bodies of the vertebræ are wanting, and the tumour then protrudes anteriorly into the thorax, abdomen, or pelvis. *Spina bifida* is most commonly met with in the lumbar or sacral regions, it is comparatively rare in the cervical or dorsal.

Pathology.—1. The walls of the sac consist of skin, but this may be absent in the centre, the dura mater and arachnoid; the fluid communicates with the sub-arachnoid space. In this form there is an accompanying protrusion of the spinal cord and its nerves (meningo-myelocele). 2. Occasionally the swelling is a "hydro-meningocele," the visceral bag of the arachnoid not being included in the sac, and the fluid being placed between the parietal and visceral layers of the arachnoid, and thus not communicating with the sub-arachnoid space. 3. Very rarely the cord forms part of the sac wall, its dilated central canal containing the fluid (syringo-myelocele.) In many cases the cord is to a greater or less extent adherent to the posterior wall of the sac, where it may follow the curve of the tumour, forming a longitudinal furrow, or pass straight across to be fixed by its terminations, producing a distinct umbilical depression. If the tumour be situated below the cord, the corda equina may pass through the centre of the sac or be spread out on its walls.

Complications.—Chronic hydrocephalus, club foot, and paralysis of the lower extremities. Nævus of the skin over the tumour is not uncommon.

Characters.—The tumour is usually of a round or oval shape; it varies in size from that of a hazel nut to that of an orange, or larger, and has a tendency to increase. It may be bilobed, have a broad base, or a narrow pedicle. The most common position is the middle line, and there may be more than one tumour in the same patient. The sac may be multilocular. It diminishes on pressure, or completely disappears; but when the compression is removed, regains its previous size; it also decreases when the

patient is recumbent, or the head is placed low. In some cases, by alternately compressing the sac and skull, fluctuation is apparent, and spasms of the limbs may present themselves. If the child's head be raised, or if it cry, the tumour swells out. The bony margin of the cleft is frequently to be distinctly felt. The integuments covering it are very smooth, delicate, and thin, but may be normal, or as a rare event thickened. Translucency is not uncommon. The contained fluid is generally thin and limpid, slightly saline, and almost uncoagulable; it resembles the cerebro-spinal fluid, with which it is identical in containing salts of soda and potash, and a trace of sugar.

Prognosis.—It is a very fatal disease, especially if the tumour ulcerate, increase rapidly, or when it is associated with hydrocephalus or paralysis. If the tumour be small, the superincumbent skin healthy, and the size stationary, a cure may result spontaneously or after appropriate treatment.

Treatment.—Palliative. If small, and the child be thriving, a pad of absorbent cotton smeared with vaseline should be worn to protect the sac, and secured by a moderate tight bandage.

Radical. (a) Pressure by means of an air pad and bandage or collodion. (β) Small punctures with a needle at the side of the tumour, followed by compression. (γ) Dr. Morton's plan is the most successful, and consists in the injection of an iodo-glycerine solution (iodine gr. xx, iodide of potassium gr. xxx, in glycerine 3j). A medium-sized trocar and canula must be used, passed obliquely through one side of the base, piercing sound skin and not the membranous sac wall. The aperture must be immediately closed by collodion to prevent the cerebro-spinal fluid escaping. Half a drachm to two drachms of the solution should be injected, according to the size of the tumour, and this is repeated at intervals of a week or longer. Contra-indications are marasmus, great and increasing hydrocephalus, and co-existing disease. The age of election is two months, but if the tumour show signs of breaking, the operation should be at once performed. (δ) Excision, if the pedicle be very small, the neck being compressed with a clamp. (e) Ligature of the

pedicle. The two last methods are dangerous.

Angular Curvature of the Spine, Caries of the Spine, Spondylitis, Potts' Disease, or Osseo-Ligamentous Disease.

It occurs generally in children or young adults, and depends on inflammation, usually of a traumatic origin, but occasionally strumous, invading the cancellous structure of the bodies of the vertebræ or the intervertebral fibro-cartilages, and leading to rarefying osteitis and caries. The most common seat of the disease at its commencement is in the bone at its junction with the deeper layers of the periosteum, or cartilage in those parts covered by the latter. The disease is now and then met with in adults in consequence of traumatic injury or the formation of syphilitic gummata. The mid-dorsal is the most common situation, but Hueter considers the twelfth dorsal and first lumbar vertebræ most liable to be attacked. The bodies of the vertebræ and intervertebral discs become completely destroyed, two or three vertebræ being as a rule involved. The spinous processes and laminae generally escape, and thus the vertebral column, under the weight of head and upper part of the trunk, bends forward, the spines projecting posteriorly. As a result of the angular curvature, the aorta is bent at a sharp angle, and this may produce cardiac hypertrophy. The cord is rarely implicated, but occasionally paralysis is present either from pressure on the cord by the displaced bone or by matter formed in the course of the disease. Pearce Gould distinguishes three forms of pressure. 1. In this form only the spinal fluid is displaced, whilst the membranes and cord are not interfered with. Thus there will be deformity, but without pain or paralysis. 2. There is not only displacement of spinal liquid, but also some degree of external pachymeningitis and interstitial myelitis of the white columns of the cord, caused by the contact of the diseased vertebræ, and accompanied by pain and paralysis of the limbs, but without loss of sensibility or reflex mobility. 3. Severe squeezing and complete transverse myelitis with absolute loss of sensation and mobility.

Symptoms.—1. Local pain. Dull gnawing pain, increased on pressure or motion; but this is often absent. Pain in the

abdomen or chest is an early symptom. 2. Rigidity of spine. The spine is fixed stiffly, the child neither bending nor rotating it, and walking with great caution. The shoulders are raised, chin thrown up, and toes turned in. 3. Spinal deformity. The spinous processes project, causing angular deformity. This is most marked when the dorsal vertebræ are affected. Compensatory curves form above and below the seat of disease. This deformity develops slowly, and the curvature is very abrupt and not gradual, like the segment of a circle. 4. Loss of strength and appetite as the disease progresses. 5. Spinal cord and nerve symptoms. Paralysis of the lower extremities may occur, preceded sometimes by spasmodic twitches or rigidity of the limbs, the power of motion being the first lost and the last to be regained. There is nearly always an uneasy sensation at the pit of the stomach, and in some cases a feeling of constriction extending round the trunk (girdle pain). Pain in the chest and about the heart. Shortness of breath and occasionally spasmodic breathing. 6. Gait and general aspect. The patient becomes unable to stand erect, raise himself, pick any object off the floor by stooping, or turn over on his side without using his arms. When walking about the room the child will support himself by the furniture, and will rest his hands upon his thighs to prevent the weight of the head and shoulders falling on the spine. If the lateral part of the bodies of the vertebræ be affected, pressure on the ribs will produce pain. When the disease attacks the lower dorsal or lumbar vertebræ, in many cases there is flexion of one or other thigh, due to contraction of the psoas muscle, and simulating the first stage of hip-joint disease.

Suppuration.—Finally in many cases suppuration occurs, which is very variable in amount. The pus may be small in quantity, undergo fatty degeneration, be removed by the absorbents, or become calcified. In other cases suppuration is profuse, forming large collections between the bones and thickened periosteum. If suppuration be absent (myelitis granulosa), the bones are honeycombed and filled with granulation tissue, but retain their shape, no deformity being present. When the dorsal vertebræ are affected, the abscess may point in the back, but

more frequently lies behind the costal pleura, and perforates the diaphragm by absorption, having become adherent to it, and thus it gains the psoas muscle. Here lying behind the peritoneum, a sheath is formed for the abscess by the fascia iliaca, thus it proceeds downwards to Poupart's ligament. The pus may collect in the iliac fossa, or perforating the abdominal wall will pass, with the conjoint tendons of the psoas and iliacus muscles, under Poupart's ligament, and point at the insertion of these muscles. When the lower dorsal or lumbar are concerned the pus enters the sheaths of the psoas and follows the above-mentioned course (psoas abscess), pointing below Poupart's ligament; it may even burrow between the muscles as far as the popliteal space, and has been known to reach the ankle. In other cases the abscess points by the side of the rectum, through the abdominal wall above Poupart's ligament, or in the gluteal region passing through the sciatic notch. In some cases the abscess passes directly backwards, forming a dorsal or lumbar abscess. These collections of pus are always of immense size. The pain is lessened when the abscess begins to discharge.

Mode of Repair is by ankylosis. When the inflammation subsides, consolidation of the injured bones takes place, forming a firm, bony mass. This process of repair begins in the posterior segments of the diseased vertebræ, adhesive inflammation occurs in the periosteum covering the spinous and other processes, ligaments, and connective tissue. The inflamed products become organised, forming a nidus for the new bone by the fibrous tissue becoming ossified. Adjacent vertebræ and the remnants of the neural arches and spinous processes become locked together by new bony processes of periosteal origin, and finally soldered into one firm, immovable mass. The heads of the ribs are generally joined in the same manner.

Diagnosis.—In the early stages the diagnosis is difficult. The diseases with which it is most likely to be confounded are hysteria, neuralgia, and rheumatism. The continuous pain in the back, increased by pressure and the application of a hot sponge or ice; the slight swelling over the spinous processes; the awkwardness of gait and difficulty in rising,

stooping, turning, or standing occurring in a child or youth will be sufficient to show the nature of the complaint. Up to the age of puberty the curves natural to the spine are not entirely formed. This condition, in conjunction with great flexibility of the spine in early life, gives rise to appearances which are often deceptive. Projections appear at various parts, more especially in the lumbar region, which are liable to be mistaken for commencing caries. If the surgeon cannot satisfy himself as to the diagnosis by careful manipulation, he may do so by placing the child in a prone position and raising the hips above the level of the spine. If there be no disease the projection will then disappear. In the later stages no difficulty can arise. The diagnosis of psoas abscess from other abscesses or tumours of the groin is not always easy. Erichsen enumerates the following causes which may give rise to abscess in the groin. 1. Large lymphatic collections in the subcutaneous or intermuscular planes of cellular tissue. 2. Disease of the cellular tissue round the kidney. 3. Pericæcal abscess (on the right side only). 4. Iliac abscess, whether forming merely in the iliac fascia or dependent on disease of the pelvic bones. 5. Hip-joint disease, the abscess being pelvic. 6. Large buboes or glandular abscesses. 7. Empyema, perforating the pleura and finding its way down behind the diaphragm. 8. Serous or hydatid cysts. From these abscesses a psoas abscess is distinguished by the pain, tenderness, and projection of the spinous processes which accompany it. From iliac abscess, which sometimes enters the sheath of the psoas muscle, a psoas abscess is recognised by the former occurring after middle age, pointing above Poupart's ligament, and coming on gradually; the latter in children, pointing below Poupart's ligament, and appearing suddenly, added to which there is pain in walking, extending the leg, and standing.

In diffuse aneurism of the abdominal aorta or iliac arteries the absence of fluctuation, history, sudden onset, and stethoscopic examination serve to differentiate this condition from a psoas abscess.

Fatty tumours do not diminish on pressure, and have no impulse on coughing.

Femoral hernia is most liable to be confounded with a psoas abscess, as they both have an impulse on coughing, and disappear or diminish on pressure; but in a psoas abscess there is a soft, fluctuating feel, an intra-abdominal portion, on removing the pressure the swelling slowly returns, although the patient remain in a recumbent position, and there be no gurgling on reduction. When the abscess points external to the femoral vessels it is clearly not a femoral hernia, and when it reaches the apex of Scarpa's triangle, though internal to the vessels, it is to the inner side, and much below the saphenous opening.

Serous and hydatid cysts are known by the character of the fluid.

Prognosis—As regards life, depends on the extent of the disease, whether there be much curving of the spine, which is favourable to ankylosis and recovery, and the size of the abscess. The deformity is usually irremediable. Recovery is a slow process, and takes from three to ten years. Death may occur from exhaustion, suppuration, septicæmia, pyæmia, hæmorrhage from the abscess opening into an artery, peritonitis, pneumonia, amyloid degeneration, meningitis, paralysis, and tuberculosis.

Treatment.—A great change has taken place in late years in the treatment of angular curvature by the introduction of Sayre's plaster of Paris jacket.

Sayre's Method of Applying the Plaster of Paris Jacket.—"The bandages in the application of this treatment must consist of some loosely woven material, such as cross-barred muslin, mosquito netting, or crinoline. This should be torn into strips 3 yards long, and from $2\frac{1}{2}$ to 3 inches wide, according to the size of the patient on whom it is to be used. Its meshes must be completely filled by drawing the bandage through very fine and freshly ground plaster of Paris that has not been long exposed to the air, this plaster at the same time *being very thoroughly rubbed into the material*. Each strip should be then rolled up so as to form an ordinary roller bandage. Several of the bandages thus prepared may be kept ready for use in an air-tight tin vessel. When required they are *set on end*, one at a time, in a basin containing sufficient depth of water to *cover them entirely*. A free

escape of bubbles of gas through the water will be observed for a short time; when this has ceased the bandage is ready for use. The surface of the skin should be protected by an elastic but closely fitting shirt or vest, without armlets, but with tapes to tie over the shoulders, and composed of some soft woven or knitted material. For the purposes of suspending the patient I make use of a very convenient apparatus, which consists of a curved iron cross-beam, to which is attached an adjustable head and chin collar with straps, and also two axillary bands. To a hook in the centre of the bar is fixed a pulley, the other end of which is secured either to a hook in the ceiling or the top of an iron tripod about 10 feet in height. The head and chin collar and the axillary supports having been carefully adjusted, the patient is gradually drawn up until he feels comfortable. Before applying the plaster bandage I place over the abdomen, between the shirt and the skin, a pad composed of a towel folded up so as to form a wedge-shaped mass, the thin edge being directed downwards. This is intended to leave room when removed for the expansion of the abdomen after meals, and so I call it the 'dinner pad.' It is important to make it thin where it comes under the lower edge of the jacket, or else the jacket would fit too loosely about the lower part of the abdomen. It should be taken out first before the plaster sets. If there be any very prominent spinous processes which at the same time may have become inflamed in consequence of pressure produced by instruments previously worn, or from lying in bed, such places should be guarded by little pads of cotton or cloth, or little glove fingers filled with wool placed on either side of them. Another detail which I have found of practical value in some cases, is the application under the shirt, over each anterior iliac spine, of two or three thicknesses of folded cloth, 3 or 4 inches in length. If these little pads be removed just before the plaster has completely set, such bony processes will be left free from pressure. If the patient be a female, and especially if she be developing at the time, it will be necessary to apply a pad, under the shirt, over each breast before the plaster bandage is put on. These pads should be removed just

before the plaster sets, and at the same time slight pressure should be made over the sternum for the purpose of indenting the central portion of the plaster jacket. The skin-fitting shirt having been tied over the shoulders, and then pulled down and kept stretched by means of tapes applied, one in front, the other behind, near its lower edge, and tied tightly over a handkerchief placed on the perineum, the patient is to be gently and slowly drawn up by means of the apparatus until he feels perfectly comfortable, *and never beyond that point*, and while he is retained in this position the plaster bandage is to be applied. A prepared and saturated roller, which has been gently squeezed to remove all surplus water, is now applied round the smallest part of the body, and is carried around and around the trunk downwards to the crest of the ilium, and a little beyond it, and upwards from below upwards in a spiral direction, until the entire trunk from the pelvis to the axilla is encased. The bandage should be placed smoothly round the body, not drawn too tightly, and especial care taken not to have any single turn tighter than the rest. Each layer of bandage should be rubbed most thoroughly with the hand by the assistant, that the plaster may be closely incorporated in the meshes of the crinoline, and bind together the various bandages which make up the jacket, thus making it much stronger than if attention be not paid to this particular. If you notice any spot which seems weak or likely to give way, pass the bandage over it and then fold it back on itself, and do this until you have placed several thicknesses of bandage over this point, being careful to wet all well together, and then pass a turn completely round the trunk to retain any ends which might have a tendency to become detached. In a very short time the plaster sets with sufficient firmness so that the patient can be removed from the suspending apparatus and laid on his face or back on a hair mattress, or air bed. Before the plaster has completely set the dinner pad is to be removed, and the plaster gently pressed in with the hand in front of each iliac spinous process, for the purpose of widening the jacket over the bony projection. In the case of a young

child with a small pelvis it may happen that the circumference of the body at the umbilicus is as great as around the pelvis, you can still obtain a point of support at the pelvis, if, as the jacket hardens, you will press it in at the sides above the ilium, and in front and rear above the pubes. If any abscesses be present they must be freely opened antiseptically at the most dependent part, and then the contents completely abstracted. After each abscess has been thoroughly evacuated, fill the cavity with Peruvian balsam, place oakum over the opening, and cover it with a piece of oil silk. Then place on this a piece of folded pasteboard larger than the abscess, carrying a long sharp pin through its outer leaf. Now pull down the shirt, and the pin will project, and each turn of the bandage can be carried over the pin without forcing it into the abscess cavity below, and the surgeon is furnished with a guide in making an opening which shall lead directly to the diseased surface. When the plaster has nearly set the bandage should be cut away round the pin until the shirt is reached, when the latter should be starred or cut in strips from the pin until an opening has been made of sufficient size to remove the pasteboard. The oil silk is starred in a similar manner, so that when the strips are reversed they will cover the edges in the opening of the plaster where they can be glued down with gum-shellac."

I have given Sayre's method in his own words, as without attention to all the details the surgeon will not obtain the success he ought. In some cases the suspension of the patient is irksome, and even attended with danger; to obviate this that excellent surgeon, Mr. Davy, has modified Sayre's plan.

Davy's Method of Applying the Plaster of Paris Jacket.—A piece of strong canvas (a common sheet or long night-shirt will do) is procured longer than the patient's height, and the arms are passed through two slits in the canvas at suitable points, so that, in the first instance, a loose canvas long apron, with ends one turned downwards over the chest and the other on the floor, fits round the front and sides of the body. This apron is then removed from the patient and a vest applied, of thicker

material, and far more open-meshed than usual. The canvas hammock is next slung, at two fixed points, by attaching its two folded ends with two strong bandages, and the patient placed in the hammock face downwards, an aperture being made over the patient's lips to permit breathing and free conversation. The surgeon leisurely applies the plaster of Paris *outside* the canvas hammock. The children are comfortable in these hammocks while the plaster is setting. When the bandage has firmly set, the whole hammock and patient are taken down and the superfluous ends above and below the plaster cut off; so that in this case the canvas remnant acts as an accessory vest to the patient's frame. More recently, Davy uses towelling for the hammock, and fastens it at one end to a broomstick, and at the other by a slip knot to a set of compound pulleys. The hammock only reaches to the chin, and the forehead is supported by a cross band of leather. The hammock is withdrawn when the plaster has set. *The general treatment* consists in good nourishing diet, tonics, as cod-liver oil, iodide of iron, maltine, etc., sea air and an occasional dose of calomel. It was formerly the practice to keep the patient on a prone couch for twelve or eighteen months, until ankylosis had occurred; but now, by Sayre's jacket carefully applied, rest is given to the spine, and a support to the superincumbent weight, whilst the patient is able to move about, except in the case of "very small children with undeveloped pelvis, when extension and the horizontal position must be used." If paralysis be present bichloride of mercury (gr. $\frac{1}{12}$ to $\frac{1}{16}$) is serviceable, and the actual cautery by the side of the affected part. Should abscesses form they must be opened as soon as possible under strict aseptic precautions. A psoas abscess, when intra-abdominal, may be opened in one or two situations: 1. Above Poupart's ligament; 2. In the loin. 1. The incision is made in the same line as that for ligaturing the external iliac artery, the structures are divided until the fascia transversalis is reached, and a pair of dressing forceps pushed into the abscess cavity, the opening dilated, the pus evacuated, and a drainage tube inserted. A Listerian dressing is used. 2. The

patient is placed as for colotomy, and a vertical incision four inches long made at the edge of the erector spinæ muscle, with its centre two inches above and in a line with the posterior iliac spine. The dissection is carried down to the quadratus lumborum which is divided for two inches, and the subperitoneal fat recognised. Then a finger is passed into the wound, and on counter-pressure being made in front, the abscess is recognised and incised. A large and long drainage tube is inserted and fastened to the skin wound, which is closed with superficial and deep sutures. The patient must be kept in bed, and on no account be allowed to raise his shoulders until the abscess cavity heal, and for six weeks afterwards. Proper pads must be kept applied over the course of the abscess.

Disease of the Atlo-Axoid Region may commence in the joints or bones.

Symptoms.—1. Unilateral pains about the back of the head or upper part of neck, occasionally pains in eating and speaking, or on deep inspiration. The pains are often referred to the larynx or scapula. In children obscure pains in the head simulating cerebral meningitis may be present. 2. Position. The head is kept perfectly fixed and rigid, being supported by both hands, all motion, and especially lateral flexion, is painful. Muscular spasm may cause wry neck. 3. Swelling about the nape of the neck due to œdema. 4. Deformity from sliding forwards of the atlas, and projection of the spine of the axis, followed by a compensatory curve in the dorsal region. 5. Appetite and strength diminish. 6. Nausea. 7. Loss of voice. 8. Dyspnœa due to post-pharyngeal abscess. The patient succumbs to exhaustion, or suddenly from dislocation of the atlas and compression of the cord. Most cases recover with ankylosis if recognised early. This disease may result from syphilis, or occur as a sequence of an ulcer of the pharynx, and seems to be more common in adults. Disease in this situation may so closely simulate ordinary wry neck that an error in diagnosis may easily be committed (Brodhurst).

Treatment.—Rest for three to six months in the horizontal position, with a small pillow under the neck and sand bags at the side of the head, followed

by some mechanical support as Sayre's jacket and jury-mast, or a collar of leather, gutta percha, or pasteboard, and the administration of tonics. It must be remembered that any sudden movement may cause instant death.

Sayre's Treatment.—If the cervical or upper dorsal vertebræ be implicated, it is necessary to treat the disease by an instrument called a jury-mast. This consists of two pieces of malleable iron bent to fit the curve of the back. To the lower portion are attached three or four strips of tin long enough to go nearly round the body, these strips are roughened like a nutmeg grater by having holes punched in them *in both directions*, in order firmly to fasten the strips to the jacket. From two iron bars, at the upper extremity of the curved iron pieces, springs a central steel shaft, carried in a curve over the top of the head, and capable of being elongated at will. To this is attached at its upper extremity, a swivel cross bar, with hooks from which depend straps supporting a head and chin collar. This cross bar must be placed above the curved steel arm, or it will be liable to become detached. The apparatus is thus applied: the patient having been encased in the usual manner in a few thicknesses of plaster roller, the jury-mast is put on over this, care being taken that the malleable iron strips are bent so as to conform to the surface of the plaster on each side of the spine, and that the shaft over the head be kept in the same line as the spinous processes. The extremity to which the swivel cross bar is attached should be over the vertex of the head, so that when the straps are applied the line of traction shall be neither too far forwards nor too far backwards. The perforated tins are carried partially round the body. The apparatus having been thus carefully adjusted, fresh layers of plaster bandage are applied over it in order to hold the instrument in its place, the assistant being careful to rub the bandage into all the inequalities caused by the instrument. After the jacket has thoroughly hardened, the chin piece is to be applied around the patient's neck, so that it supports the chin and occiput comfortably, and the straps attached to it are hooked on to the cross bar, the degree of traction made upon them

being regulated by the feelings of the patient.

If abscess occur it points at the back of the pharynx and should be opened there. This is best done by a flat trocar and canula, so that the pus is evacuated well out of the way of the air tube. The abscess may point at the sides or back of the neck, most usually in the posterior triangle in front of the trapezius or close to the posterior border of the sterno-mastoid. Very rarely the abscess enters the posterior mediastinum, and may burst into the pleura, pericardium, or running forward open under the edge of the rib. The abscess may also, as a rare event, pass under the clavicle and then run down outside the thorax.

Lateral Spinal Curvature—Scoliosis—occurs most frequently between the ages of seven and seventeen, and is most common in the female sex. The nature of the disease appears to be a relaxation of the ligaments and muscles of the spine, from general debility or atonicity, especially in those whose growth is not complete; this produces a *lateral deviation* of the vertebral column, and *rotation* of the vertebræ on their axes. The first stage commences with disinclination to move, and the body stoops and is ill-balanced, particularly in the evening and after any fatigue. Secondly, the natural spinal curves are modified, the loins being straightened and the back and shoulders rounded. Thirdly, the spine becomes curved laterally. The part of the spine chiefly affected is the dorsal region, which is curved with the convexity to the right, thus occasioning the corresponding shoulder and scapula to seem larger than natural. As the disease advances a compensatory move takes place in the lumbar region with the convexity to the left, causing the hip on the side of the lumbar convexity to appear unduly prominent. Brodhurst, however, is of opinion that “in ninety-five cases in every hundred the lumbar curve is the primary and the dorsal the secondary curve; that is to say, in these ninety-five cases the cause is from below (flat-foot, knock-knee or both, or muscular weakness) occasioning an oblique pelvis and a lumbar curve with a consecutive dorsal curve. The primary curve is always the bolder.” In whatever way the curvature is produced the bodies of the dorsal vertebræ

at the same time are necessarily rotated backwards towards the left upon the articular processes of the concave side as pivots, and those of the lumbar region towards the right; so that the front of the bodies look towards the convexity and the tips of the spinous processes towards the concavity of the curve. As a sequence of rotation of the vertebræ, the ribs undergo a similar change; on the convex side of the curve they are spread out like a fan and rotated backwards; on the concave side they are contracted and rotated forwards. The entire thorax is enlarged on one side and diminished on the other. The scapulæ follow the ribs. The aorta accompanies the curvature of the vertebræ, and will thus lie out of its usual course and might be mistaken for an aneurism. Together with severe lumbar curvature, Brodhurst points out that there is always found obliquity of the pelvis. This is not a simple tilting to one side, but there is at the same time a slight movement of rotation of the pelvis itself; so that the anterior superior spinous process of the ilium is not only raised above that of the opposite side, but is also thrown back; while on the other side it is depressed and carried forward. In the male the triangular ligament of the urethra with the rest of the pelvis is twisted, and consequently the direct course of the urethra behind the ligament no longer corresponds with that in front, and this may cause a serious impediment to the introduction of a catheter into the bladder. In addition to being displaced, the vertebræ are compressed and accommodative absorption takes place from pressure, although the bones are not diseased. In severe cases buttresses of new bone are found within the concavity of the curve.

Mechanism.—The strength of the spine depends on the manner in which the individual bones composing it are united by strong ligaments and supported by powerful muscles; if from any cause these connecting media become weak, the spinal column yields under the weight of the head and superior extremities, and bends usually in a lateral direction. Sometimes the curve is backwards, cyphosis, being an exaggeration of that which naturally exists in the cervical and upper dorsal region, in other cases it is forwards, lordosis, and manifests itself in the lum-

bar region, where such a curve is normally present.

Causes.—Pirrie arranges the causes of lateral curvature thus: 1. Debility or muscular atony and relaxation of the spinal ligaments; 2. Hypertrophy as of the muscles of an upper extremity; 3. Atrophy, the result of paralysis, of local inflammation, of amputation of an upper extremity, or of an ankylosis of the elbow or shoulder; 4. Spasm of the muscles of the neck or back; 5. Obliquity of the pelvis, as is produced by unequal length of legs; 6. Rickets; 7. Altered capacity of one side of the thorax; 8. Deficiency or excess of development of the bodies of the vertebræ. Debility is the most common cause, and may be general or local. General debility may result from the age of puberty, rapid growth, want of proper exercise, anæmia, sedentary occupations, protracted fevers, etc. Local debility affecting the spinal muscles, arises from long continued maintenance of the erect position, habitually keeping the body in a bent posture, as in drawing, writing, sewing, playing the piano, etc. Arrested growth from tight lacing also enfeebles the spinal muscles.

Hypertrophy is occasioned in various ways. The excessive use of one arm as exemplified in blacksmiths, compositors, seamstresses, etc., produces increased development of the muscles which, having their origin at the spine act on the upper extremity, and thus these overpowering their antagonists produce a marked curvature. In a similar manner any cause which will occasion atrophy of these muscles by permitting free action to the healthy side, is followed by curvature. Similar consequences result from spasmodic contractions of the muscles as in wry-neck. "Inequality in the length of the lower limbs, whether produced by a bent tibia or femur, by flat-foot, or knock-knee, by muscular contraction, articular disease, or by partial loss of muscular power, will induce obliquity of the pelvis and a primary lumbar curve" (Brodhurst). In rickets the bones are too soft to resist the action of the muscles. Altered capacity of one side of the chest as a cause of lateral curvature is exemplified by what occurs in empyema, the ribs falling in on the affected side, the shoulder being depressed, and the muscles being weakened, so that the spine is drawn over to the healthy side.

Symptoms.—The earliest is a prominence of the right scapula, due to the bulging of the thorax beneath and outside the angle of the scapula as the result of the dorsal curve; on account of this, patients complain that their shoulder is "growing out." A posterior projection of the innominate bone, marked by a protuberance backwards just outside the sacro-iliac joint, is also an early sign, and is due to the lumbar curve; at the same time the left hip appears enlarged. To examine the spine, the patient's back should be stripped as low as the trochanters, and she should be standing opposite the light, with her boots off. The heels should be together, the knees straight, and the arms at the side; each spinous process being marked with an ink spot, and the levels of the crista ilii and scapulæ, the deformity can be readily recognised. If in doubt, make the patient lean forwards with her hands together, as if to touch the ground, and rise slowly, when any irregularity or rotation will be visible. "Distortion of the spine is never stationary, but it advances slowly, until at length ankylosis takes place between the bodies of the vertebræ and also between the articulating processes." As the disease progresses, the distortion becomes increasingly apparent, the trunk is shortened and seems compressed, the ribs are compressed from side to side and bulged forwards. In very advanced cases, owing to extreme rotation of the vertebræ, the angles of the ribs on the inner side are carried so far backwards as to form a prominent ridge concentric with the spinous; and finally proximal ends of ribs from the articulating surfaces to the angles are twisted round the long axis of the spine so as to touch the sides of the vertebræ and be coiled on them. The viscera of the thorax and abdomen are compressed, their functions disturbed, and the nutrition of the body impaired, producing debility, pallor, loss of flesh, palpitation, fainting, difficult respiration, etc. When the curve is recent the spine can be restored to its normal length, but after a time the curve is permanent. Cases due to paralysis of the muscles of the back, or in which there is osseous deformity, are very unfavourable.

Treatment.—1. Remove predisposing and exciting causes; good food, moderate exercise, and iron, are the general measures to be adopted. 2. The patient

should recline as much as possible on an inclined plane, with a pillow under the lumbar region. She should not stand or sit much. Noblé Smith advises the prone position on a couch made horizontal beneath the thorax and slanting slightly from the pelvis towards the feet. 3. Manipulations by a rubber to the spinal muscles. 4. Locally, Sayre's plaster of Paris jacket, worn as a corset and removed at night and for gymnastic exercises, or Chance's apparatus. 5. Methodical exercises repeated, but limited, to strengthen the muscles of the back. 6. Cold sponging is useful.

In cases when rotation has taken place, a mechanical support is useful, consisting of a thin metal band round the hips, two steel bands along the spine, arm-pieces, and an elastic belt round the abdomen, with, if necessary, a side piece to press on the ribs. Noble Smith recommends an apparatus invented by E. J. Chance. He thus describes it: "A belt surrounds the pelvis, a single upright rod passes from this belt as high as the shoulders; a pad, movable by a key, is attached to the upright rod; shoulder straps proceed from this pad; an abdominal belt is attached by straps to a pad opposite the lumbar region, and this pad is fixed to the upright rod. The apparatus is so fitted that when the patient is seated the lower portion of the pelvic belt comes in contact with the chair, so that the support in resting the back is complete. In more severe cases lateral plates are fitted to the upright bar, which can be accurately adjusted to the curves. The plate upon the convex side of the dorsal curve is counterbalanced by the plate which is placed against the side of the thorax beneath the arm of the opposite side."

Bernard Roth recommends the following twelve exercises for strengthening the spinal muscles. 1. Lying on the back, arms by the side of the body, hands supinated, slow and full inspiration by the nose, slow expiration by the mouth (repeated four times). 2. Similar exercise with the arms extended upwards by the side of the head. 3. Same position as 1, head rotation, on axis to right and left alternately, also lateral flexion of the head to right and left alternately four times. 4. Lying on the back, slow simultaneous circumduction of both shoulder-joints from

before backwards, elbows and wrists extended (twelve times). 5. Same position as 2, hip circumduction, both ways slowly; knees kept extended (ten times). 6. Lying on the back, simultaneous extension of the arms upwards, outwards, and downwards from a position with the elbow flexed and close to the trunk (four times). 7. Lying prone; hip circumduction both ways; knee kept extended (ten times). 8. Sitting on a couch with the back at an angle of 45° ; ankle circumduction downwards, inwards, upwards, and outwards, the toes being directed inwards the whole time (twenty times); also foot abduction (patient resisting); abduction (surgeon resisting) (eight times). This may be omitted if there be no tendency to flat foot. 9. Lying on the back, arms extended upwards by the side of the head; slow flexion of both arms (surgeon resisting by grasping the hands), followed by extension (patient resisting) (six to eight times). The patient's knees flexed over the end of the couch or table, fix the trunk. 10. Patient sitting astride a narrow table or chair without back, with hands supinated, and arms down, trunk flexion at the lumbar vertebrae (patient resisting slightly), followed by trunk extension, surgeon resisting by his hand against the back of the patient's head (six to ten times). 11. Patient, with arms extended upwards, leans against a vertical post or door, fitted with pegs on each side, which he grasps; the surgeon gently pulls the patient's pelvis forwards by his hands on the sacrum (patient resisting), and the patient then moves back the pelvis to the post or door, surgeon resisting (six to eight times). At no time are the patient's heels to be raised from the floor; also pelvis rotation on its axis to right and left, alternately (surgeon resisting with his hands on each side of the pelvis) (six to eight times). 12. Lying on the back with the head and neck projecting beyond the end of the table, arms by the side of the body, hands supinated, the head is gently flexed by the surgeon's hand on the occiput (patient resisting), followed by head extension (surgeon resisting) (eight times). The patient should rest for a minute or two between each exercise on a couch or chair, with a movable back placed at an angle of 45° . During all exercises, except

that of respiration, the patient should count aloud. In a few days, if there be no backache, the following standing exercise is done: the patient with the feet slightly apart, and the heels fixed against a ledge or wall, rests with the front of the thighs against a low padded horizontal bar; whilst holding herself as erect as possible, the surgeon then gently flexes the patient's trunk, by pressing his hand against the back of her head (patient resisting), and then the patient slowly resumes the vertical position (surgeon resisting). In about three weeks or a month the following exercises can be tried, known as "Forward lying, heels fixed, trunk extension and flexion." The patient lies prone with the pelvis and legs supported, and the heels fixed (the latter best by some

one sitting on them) on a padded table, while the head and trunk, to the level of the iliac crests, project beyond the edge of the table. The patient slowly raises the trunk to the level of the pelvis and slightly higher, and then slowly allows the trunk to be flexed by its own weight. Another good exercise Roth describes as "Long sitting, trunk extension and flexion." The patient sits on a table with the legs extended and knees together; an assistant sits on the table just above the feet to fix the legs, the patient slowly extends the spine against the surgeon's resistance until the trunk is at the same level with the legs; the patient then gently resists while the surgeon raises the trunk again to a vertical position.

CHAPTER XXVII.

INJURIES AND DISEASES OF THE FACE.

Wounds about the face are of frequent occurrence. They are followed by copious bleeding, due to the great vascularity of the parts, and from the same reason heal with rapidity. The edges must be accurately adjusted to prevent an unsightly scar, and this is best achieved by fine catgut, silver or silk sutures; or, if there be much bleeding, by harelip pins and a twisted suture, as this will arrest the hæmorrhage at the same time. Styptic colloid is a good dressing for these injuries.

Complications which may occur are hæmorrhage, retention of foreign bodies, erysipelas, emphysema, and disturbances of vision.

Salivary Fistula presents itself when the parotid duct is included in a wound of the cheek. The wound does not close, and much inconvenience is caused by the saliva being discharged on the cheek.

Treatment.—If recent, the edges may be pared, accurately brought together by a fine needle and figure of eight suture, and pressure applied by means of styptic colloid. If of old standing the aperture into the mouth will probably have closed, and the following method is necessary: A needle threaded with silk is passed into the fistula, and

then turned slightly backwards and thrust through the cheek into the mouth. The needle is then withdrawn, the thread being left in the mouth. The needle is now threaded with the other end of the silk and again passed into the fistula, only this time it is directed forwards and so through the cheek into the mouth, again unthreaded and removed. Finally, both ends of the thread are knotted firmly together inside the mouth, and allowed to cut their way through. The external edges of the wound are pared and united by a harelip suture.

Foreign Bodies are sometimes thrust up the nostrils or in the meatus of the ear. Foreign bodies in the ear are classified by Poulet into: (A) Animate—Insects, fly, flea, bug, cricket, lady bird, centipede; (B) Inanimate; (a) Regular. 1. Hard and unchangeable—Teeth, cylinders of graphite, tin or copper ball, lead, balls of lead, brass buttons, marbles, coral beads, etc. 2. Friable.—Glass, beads of glass, shells, porcelain buttons, doll's head. 3. Organic and Changeable.—Beans, dried peas, coffee beans, pellets of paper and thread, cherry or plum stones, sugar, fruit stones, elder pith. (B) Irregular. 1. Soft, and can be cut.—Grains of

oat, corn, head of barley. 2. Firm.—Pins, needles, ferrule of an iron penholder, molten lead, corset eyelets, etc.

Symptoms.—Diminution or loss of hearing, roaring noises in the ear, tinnitus pain, very often acute, especially if the body be in contact with the membrana tympani. Reflex disorders, as tickling of the fauces, excessive secretion of the saliva, cough, vomiting. Symptoms due to compression, as pain of a neuralgic character shooting up the side of the head, vertigo, facial paralysis, perforation of the tympanum.

Sequelæ.—Otitis, followed by suppuration and otorrhœa, ulcerations; cephalgia, followed after a long period by meningitis, cerebral abscess, necrosis, or epilepsy.

Terminations.—1. Tolerance. 2. Spontaneous expulsion (rare). 3. Continuance of symptoms. 4. Death.

Diagnosis should always be made out by the sight. Brunton's otoscope, or the mirror of the laryngoscope or ophthalmoscope, will reflect sufficient light into the auditory canal. If no foreign body can be detected in the one ear, search the other. Should no foreign body be visible, on no account must an attempt be made at removal, even though the patient be most positive in his assurances as to its presence.

Treatment.—Injections of warm water should be first tried, except in the case of peas and the like. Hooks, as a bent probe, or Græfe's cystotome, scoops, straight and curved forceps, wire loop, brush dipped into glue, are all useful. In old-standing cases chloroform is of great assistance. It is well to remember how shallow the auditory canal is in children or the tympanum may be injured.

Foreign Bodies in the Nasal Fossæ are divided by Poulet into (A) Animate.—Insects, leeches, flies, centipede. (B) Inanimate. (a) Regular.—1. Mineral and hard, as marbles, doll's head, iron ring, chemise buttons, shoe buttons. 2. Organic and hygrometric, as peas, beans, fruit stones, kidney beans. (β) Irregular.—1. Inorganic and hard, as small stones, pieces of shell, pieces of feather, screw, etc. 2. Organic and hygrometric, as pieces of briar twig, cork, bits of wood, carpenter's pencil, etc.

Symptoms.—Sneezing and epistaxis, watering of the eyes, pain in the nose, fauces and head, obstruction of the nasal fossa.

Secondary: The foreign body may become encrusted, purulent ozæna may arise, and occasionally necrosis.

Diagnosis is made with the nasal speculum and laryngoscopic mirror, as for the ear. The presence of a foreign body in the nose should always be suspected in a child who has a discharge from one nostril, the other being healthy.

Terminations.—1. Tolerance. 2. Spontaneous expulsion. 3. Chronic ozæna.

Treatment is similar to that for the ear. I have found most cases easily treated by means of a bent probe.

Wounds of the Orbit are dangerous, as the eyesight or brain are liable to be implicated. In a case which occurred in my practice, a young man was wounded by a single-stick, which penetrated under the upper eyelid and fractured the orbital plate of the frontal bone. He appeared quite well for two days, and then meningitis set in, leading to his death. The external wound was with difficulty discernible on minute examination.

Mouth Wounds are rarely met with except from gunshot injury. They must be treated on ordinary principles.

Tongue. This is occasionally wounded by the teeth during a fit, dentist's forceps, stem of pipes, etc. The bleeding is copious, and must be restrained by ice, a ligature, torsion, actual cautery, or perchloride of iron. Sutures as a rule are not required unless a portion be almost separated, when thick silk sutures should be used, passing deeply into the substance of the tongue; union is very rapid, and should be aided by antiseptic gargles.

The Palate and Pharynx are liable to injuries from gunshot wounds, or anything held in the mouth being forcibly driven backwards. If necessary, sutures must be applied. Before removal of a foreign body always compress the carotid.

Diseases of the Face.

The Nose.—*Epistaxis*, or bleeding from the nose, is liable to occur at any period of life. It may be primary, traumatic, or spontaneous depending upon some intra-nasal lesion; or secondary, due to general constitutional conditions or diathesis. Primary epistaxis is met with from external violence, or as a symptom of new growths, ulcers, or other local cause; it usually occurs from one nostril. Secondary epistaxis may occur in

the young about the age of puberty, from a congested state of the blood vessels, and occasionally the flow is vicarious to menstruation. In the adult, secondary epistaxis is either due to a state of plethora and congestion, often associated with disease of the liver; or occurs in cachectic and anæmic persons, especially those suffering from chronic disease of the kidney or liver. The exciting causes are violent straining efforts, as in lifting heavy weights, rowing, running, vomiting, defæcation, violent coughing, sudden changes in the temperature. Epistaxis is common in influenza, measles, scarlatina, remittent, typhoid, and relapsing fevers, hæmorrhagic diathesis, purpura, scurvy, variola, whooping cough, emphysema, heart disease, and lukæmia.

Treatment.—In the young, cold to the nose, forehead, and nape of the neck, by pounded ice, is generally sufficient, followed by a saline aperient. In adults, if the epistaxis depend on a state of plethora, elevation of the arms to a vertical position, dry cupping between the shoulders, icebag to the forehead, placing the feet and legs in hot mustard foot-baths and keeping them there for some length of time, pressure on the facial artery as it runs over the lower jaw, spinal hot-water bag to the cervical and upper dorsal vertebræ, with perfect rest in as far as possible a horizontal position. In anæmic conditions these means often prove insufficient, and the injection of ice-cold water into the nostril by means of an Esmarch's irrigating apparatus suspended high above the head, or a Higginson's enema apparatus, should be tried, whilst the patient's mouth is maintained widely opened. Perchloride or sulphate of iron, gallic acid, matico, alum, or haseline may be added to the water. Irrigation with water as hot as can be borne often succeeds when cold fails. As internal remedies: subcutaneous injection of ergotin into the muscles is an excellent measure; by the mouth, gallic acid (gr. x om. 2 hor.); ol. terebinth. (m xx—xxx); or ext. ergot. liquid. with digitalis and opium. Should more efficient means be required it will be necessary to plug the anterior nares by introducing a piece of sponge or lint saturated with a solution of perchloride of iron. Howard's dilatable nasal india-rubber plugs are very useful, and should be employed in

preference to plugging the nares. If the hæmorrhage still continue, the posterior nares must be also plugged. A plug is made of lint, one inch broad and half an inch thick (size of first joint of the surgeon's thumb), and tied in the middle of a yard of double whipcord. A long piece of whipcord is then passed by means of Bellocq's sound or a gum elastic catheter, along the floor of the nose, to the pharynx; the surgeon's finger is passed into the mouth, and seizes the cord hanging from the sound or catheter, which instrument is then withdrawn from the nose. The string of the plug is then attached to the end of the string hanging between the lips; on pulling the other end which hangs from the nostril the plug is carried to the pharynx and adjusted, being guided by the surgeon's finger over the soft palate. The plug for the anterior nares is then fixed, and the strings of the posterior plug tied tightly over it. The cord hanging from the mouth must be fastened behind the ear by a piece of plaster, to enable the plug to be withdrawn; if this precaution be neglected much trouble may be experienced in removing the plug, which becomes covered with mucus, and is not readily seen or felt. In such a case it is best to pass a female catheter along the floor of the nose, and seize the plug by a pair of polypus forceps introduced through the mouth. When both outlets are plugged the bleeding ceases as soon as the nasal cavity is filled with blood, which serves to compress the vessels. If blood run from both sides the operation must be repeated on the other nostril. It must not be forgotten that death has resulted from neglected epistaxis in many cases. The plugs must be withdrawn in from forty-eight hours to three days, as they are apt to occasion septicæmia or pyæmia if retained too long: the nose should then be syringed out with some antiseptic. In extreme cases of epistaxis, transfusion is of great service.

Ozæna or Rhinorrhæa is a fetid discharge from the mucous membrane and nose.

Cause.—1. Accumulation and degeneration of common antral secretion, generally following a cold. 2. Fetid discharge from a tooth abscess opening into the antrum. 3. Abscess and ulceration of the mucous membrane, usually

arising from syphilis, scrofula, mercury, or after the exanthemata. 4. Foreign bodies, rhinoliths, or polypi. 5. Traumatic injury. 6. Ulceration of the cartilages. In examination of the nose, the finger may be passed into the anterior or posterior nares: a nasal speculum with the light reflected from a mirror is also required. In difficult cases give an anæsthetic. To examine the posterior nares use the laryngoscopic mirror, illuminated by the frontal mirror or electric lamp. Ozæna often commences in early life, and is accompanied by a broad and flattened appearance of the nose; in the majority of such cases it is due to scrofula. In many cases there is not only ulceration of the mucous membrane, but also necrosis of bone. When syphilitic, abscesses form in the mucous membrane, chiefly at the back of the nostril, or in the septum, often followed by necrosis. This is accompanied by ulceration, the ulcers being either superficial, or deep, excavated, and sloughy, with a discharge of thick, lumpy, greenish black inspissated mucus. The discharge may collect in the nasal cavity forming incrustations, which become detached at intervals of a few days, and are again formed. The ulcers are irregular, run together, and increase on one side whilst healing on the other. The disease frequently spreads to the palate. In some cases of ozæna, as Cæsar Hawkins has pointed out, the frontal sinuses are implicated in the disease, and become distended with pus, which is then relieved by copious discharge: sleeplessness is a marked symptom of this condition.

Treatment.—Locally, glycerine of tannin, nitrate of silver (gr. xxx to ʒj), or chloride of zinc gr. xv to olive oil ʒj are serviceable, applied with a brush. Injections by means of a nasal douche or Higginson's syringe, are of great value, such as alum, iodine, carbolic acid, chloride of zinc (gr. $\frac{1}{8}$ to ʒj), permanganate of potash, alkaline phosphates, or black wash. Dusting powders to snuff up the nose are occasionally advantageous; the best is white precipitate gr. iv, or red precipitate gr. iv, with powdered sugar grs. 232. Inhalations of iodine vapour are sometimes of benefit. In certain cases soluble bougies passed up the nostril and allowed to melt should be employed; the best are those

containing sulphate of copper, iodoform, carbolic acid, or tincture of rhatany.

Should there be diseased bone, this must be removed when loose, by dressing or sequestrum forceps, all bleeding being checked by the hot douche applied with a Higginson's syringe. If necessary, Rouge's operation must be performed. This consists in making an incision through the reflection of the mucous membrane of the upper lip where it joins the gum, and freeing the lip and nasal cartilages by the bistoury and scissors from the bone, so that they can be lifted up towards the forehead, and the nasal cavities exposed. If necessary, the septum nasi can also be separated from the maxillary crest with the scissors. After the cavities have been explored and any dead bone removed, the parts are accurately replaced and secured by strapping. Healing is very rapid.

General Treatment.—Iodide of potassium, grey powder, quinine, mineral acids, arsenic, iron, iodide of iron, cod-liver oil, and cubebs, are the most reliable drugs. A seton at the back of the neck succeeds sometimes in obstinate cases.

Polypus is a tumour attached by a pedicle blocking up the nasal cavity. There are three kinds of nasal polypi. 1. Simple, benign, gelatinous or mucous polypus. 2. Fleishy or fibrinous. 3. Malignant.—1. The mucous polypus grows from the mucous membrane covering the upper and middle spongy bones, sometimes from the inferior turbinate bone, but never from the septum or the roof of the nose. It is an elastic, moist, semi-translucent, soft, gelatinous tumour, usually pear-shaped, and of a greyish brown colour. Its surface is smooth and shining, covered with ciliated epithelium, and presenting a few small vessels. Except at its neck it is not vascular, but the pedicle contains largish vessels which readily bleed. It is devoid of sensibility and is myxomatous in structure. One peculiarity about this tumour is its hygrometric character, expanding in damp weather and shrinking in dry. The polypi seldom exist singly, and are often met with in large numbers and of all sizes; they are most frequent in middle age.

Symptoms are chiefly those of a mechanical character, and are worse in

moist weather. Obstruction of respiration, running from the nose, often profuse, voice thick and nasal, sleep embarrassed and attended with loud snoring, the head being thrown back and the mouth kept open. Bronchial asthma has been noticed in several cases. Deafness may result from co-existent thickening of the membrana tympani, or obstruction of the Eustachian tubes. Smell and taste are impaired or lost. On stopping the free nostril, the patient is unable to breathe perfectly through the affected side, and feels the tumour moving to and fro; the surgeon may hear a peculiar noise like the flapping

of a frog. To render the diagnosis certain the polypus must be seen or felt. On examining the nasal cavity with the speculum, the lower part of the polypus will come into view on the patient forcibly blowing through the nostril; the size and situation of the growth is ascertained by means of a probe. As the tumour increases in size it causes the nasal cavity to become flattened, broad, and dilated (frog face), and may produce disease of the spongy bones, and also prevent the tears flowing down the nasal duct.

Diagnosis.—The following table from Southam's work is concise.

DIFFERENTIAL DIAGNOSIS OF MUCOUS OR GELATINOUS AND FIBROUS POLYPI.

Origin.	Mucous membrane covering the middle or inferior turbinated bones.	Periosteum of the roof of the nasal fossa, or the base of the skull behind the posterior nares; less frequently from the septum.
Structure.	Myxomata or fibro-myxomata, often containing adenoid elements.	Fibrous tissue or imperfectly formed fibrous tissue, mingled with sarcomatous elements, or pure sarcomata.
Number.	Usually multiple.	Usually single.
Shape.	Pear-shaped, pendulous, and pedunculated, with a narrow base.	Irregular, with a broad base moulding itself to the cavity in which it is contained.
Colour.	Greyish, semi-translucent, and glistening.	More or less red, opaque, and fleshy.
Consistence.	Softish.	Firm and resistant.
Hæmorrhage.	Not often profuse.	Frequently occurs, often a prominent symptom.
Discharge.	Constant, thin, mucoid discharge.	More scanty and sanious, liable to become foul and ozenic.
Influence of weather.	Hygrometric in character; in dry, warm weather they contract, and the symptoms are alleviated; in damp weather they enlarge, and the symptoms are aggravated.	Undergo no change of volume with changes of weather.
Progress.	Slow and stationary.	Tend to increase in size more or less rapidly.
Deformity.	Sometimes produced; less common than in fibrous. Slight expansion and flattening of the nose may be present and epiphora from obstruction of the nasal duct.	Often considerable from expansion of the bridge of the nose. Epiphora often present from pressure on the nasal duct. May encroach on the cavity of the mouth, depressing the palate, or growing into the antrum, may expand it and produce prominence of the cheeks or other deformity.

Treatment.—1. *Application of various drugs:* Malgaigne recommends this formula—

℞ Ferri perchlor. ʒj
Aq.æ. q.s. to make a thick paste.

Bryant prefers tannin as a snuff applied by a bent glass tube, or a spray composed of equal parts of alcohol and boracic acid (gr. x to ʒj). Salicylic acid is a useful snuff. Primus paints the

growth several times a day with the following mixture—

℞ Opium ʒij
Saffron ʒvj
Cloves ʒj
Cassia bark ʒj
Sherry wine ʒxxx.

Prepare by maceration.

Another remedy which has been used is a saturated solution of bichromate of potash applied with a brush. All these astringent applications are also very useful after polypi have been removed by forceps, to restore the mucous membrane to a healthy condition.

2. *Injection*.—Injections into the substance of the polypus of a solution of tannin, liq. ferr. perchlor., carbolic acid, or acid. acetic. glacial. by means of a hypodermic syringe, are often successful.

3. *Evulsion* is best effected by the forceps. Dressing forceps with well serrated blades are most frequently employed, but Gant advises, “polypus scissors forceps,” one edge of each blade being that of ordinary scissors, the other broad and rasped. The patient is seated on a chair in a strong light, a towel is placed over his shoulders to protect his clothes, and a basin at hand to receive the tumour and the blood. The patient’s head being thrown well back and supported by an assistant, the operator passes the forceps up along the sides of the polypus until the root is reached, which is then seized by compressing the handles and twisted off by rotating the instrument several times on its axis. The tumour thus severed from its connexions is then withdrawn. A forefinger should be passed behind the soft palate so as to meet the forceps and insure the posterior nares are cleared. Sometimes it is a help to draw on the body of the polypus with one pair of forceps, and use another to seize its neck. The operation must be repeated as often as any polypi are felt, until the nostril is cleared and the patient can blow through it. The hæmorrhage, which is often profuse, can usually be stopped by hot water and a Higginson’s syringe. In a week or two the nasal cavity must be again examined, for from the descent of fresh growths it is liable to be again obstructed; if so, these must be removed.

Should the polypus make its way through the posterior nares and be lodged

behind the pharynx, it may generally be removed by curved forceps introduced through the nostril or mouth; or it can be ligatured by means of whipcord or a wire loop passed through the nose into the pharynx, guided by the finger round the body of the growth, and then pulled up to the pedicle. The ends are then passed through a double canula and tightened every day until the polypus falls off, or Hilton’s nasal polypus snare can be used, the growth being at once removed. Maissonneuve made a button-hole from before backwards in the middle line of the soft palate, drew the polypus through this into the mouth, and then removed it by the knife, wire loop, or ligature (*boutonnière palatine*). If necessary from the return of the polypus after removal, Rouge’s operation can be performed, and the part of the bone from which the neck of the polypus grows, removed.

Fleshy or Fibrous (Fibro-Sarcomatous and Sarcomatous) Polypus springs from the periosteum. It is remarkably firm and resistant, smooth, globular, opaque, and of a red colour. It is not affected by changes of weather. It arises from the roof of the nasal fossa, the base of the skull behind the posterior nares, or the posterior part of the septum, extending into the pharynx, nasal cavity, or both (*naso-pharyngeal*). It is almost always single, and is met with at any age, but the *naso-pharyngeal* polypus is most common in young adult males. The structure is fibrous, but often associated with sarcomatous elements; the blood supply is very rich, the vessels having thin walls and easily giving way. The deformity produced is, as a rule, considerable, the surrounding bones being displaced and encroached on: it may grow into the antrum, pterygo-maxillary fossa, orbit, descend into the throat, protrude externally and press against the walls of the nose and mouth in every direction; from expansion of the bridge of the nose the so-called *frog-face* is produced. Its growth is frequently rapid, and it attains a large size. As the growth increases by pressure on neighbouring organs it occasions symptoms as deafness, epiphora, etc., and may even absorb the base of the skull and press on the brain; at this time headache, drowsiness, mucous, and often fetid discharge, together with obstruction of the nostrils, are pre-

sent. Considerable and oft-recurring epistaxis is a frequent accompaniment. After removal, the tumour is very apt to return; but in a few instances spontaneous cure has occurred by sloughing.

Treatment.—1. If the pedicle be small, removal may be practicable by the methods used for mucous polypi. 2. Rougé's operation in more severe cases will secure a good view of the growth, when it can be extirpated by excision, wire snare, galvanic cautery, etc. 3. Furneaux Jordan recommends the following procedure: "The leading principle of the operation is to thoroughly uncover the bony orifice of the nasal cavity. This is done by making a triangular flap out of the upper lip and side of the nose. A curved bistoury is carried under the lip into the nostril, and made to cut its way out. Then the soft part of the nose is divided on one side of the middle line, in a line with the cut on the lip. A few touches of the knife permits the flap to be turned well outwards. The nasal cavity is found expanded, well defined, and open to any sort of manipulation. To and fro traction by one or two fingers in the pharynx and one or two in front, aided perhaps by snips of scissors or knife, readily detach the tumour, which falls into the hand in the mouth." If the bone opening be too small it may be enlarged with strong bone forceps. The wound is closed with stitches. 4. By removal of the upper jaw, access can be obtained to the tumour. Langenbeck incises the parts down to the bone as in excision of the upper jaw, saws through the bone in the same line, divides the palatal attachments, but leaves those to the nasal and frontal bones undisturbed. He then turns up the jaw with its coverings over the eye, and after the tumour is removed replaces the jaw and fixes it by sutures. The soft palate is not divided. 5. If the tumour be very extensive and vascular: (a) Perform tracheotomy; (b) Plug the pharynx with a sponge attached to a string and soaked in carbolic acid solution; (c) Excise the upper jaw; (d) Remove the tumour by the galvanic écraseur. 6. Electrolysis is very useful in reducing the size of these tumours, and arresting bleeding. After the polypus has been removed by any of these methods, the bone from which it arises should be freely scraped and cauterised. The patient must be watched for any recurrence, the

cautery being applied if the stump appears suspicious.

3. *Malignant Polypi* may be sarcomatous, or carcinomatous. These bleed profusely from the slightest injury, are very soft and elastic, grow with great rapidity, and are prone to affect the glands, more especially those at the angle of the jaw. These growths rapidly encroach upon surrounding structures, expanding and separating the bones of the face, and soon invading the antrum and other parts of the superior maxilla. There is much pain, and an abundant fetid discharge. The disease soon proves fatal, either from hæmorrhage, asphyxia, implication of the brain, or cachexia.

Treatment.—If seen sufficiently early, removal of the bones implicated and the diseased integuments. In other cases only palliative measures can be employed.

The nose is liable to be attacked by epithelioma, lupus, rodent ulcer, syphilis, nævus and lipoma.

Lipoma, or Hypertrophy, consists in an overgrowth of sebaceous glands, cellular tissue, and skin, together with enlargement of the capillaries and small veins accompanied with serous exudation or fibrinous infiltration. The lipoma forms a reddish blue mass, more or less pedunculated, soft, and lobulated, situated at the end of the nose.

Treatment.—An incision is made along the middle of the nose, the skin is reflected, and the lipoma dissected off the alar cartilage on either side; the surgeon must take care not to cut the cartilage, and in order to protect it, should keep his finger in the nostril. Bleeding is checked by pressure or styptics.

The Lip.—Epithelioma is not uncommon, attacking the lower lip of males who have passed the middle period of life. The usual cause seems to be some local irritation, as smoking a clay pipe, or a sharp broken tooth. It commences at the margin of the lip, at or near the junction of the skin and mucous membrane, either as a hard warty growth which gradually ulcerates; or as an indurated crack or excoriation, with an inflamed and thickened base, which increases progressively; or as a small indurated tubercle which peels, ulcerates and scabs. Epithelioma has an irregular warty appearance when fully established, and when ulcerating, thickened everted edges and an indurated base. After a

time it extends along the border of the lip, and to the other component labial structures, and if untreated, will invade the gums, jaws, and neighbouring lymphatic glands. The part is at first stiff and uneasy, then hard and rigid, and finally gives way. The pain is characteristic, being of a burning or lancinating kind. The open surface is the seat of a blood-stained fetid discharge, and in many cases, from time to time sharp hæmorrhages occur. The glands which first become enlarged and indurated are the submaxillary.

Diagnosis.—Epithelioma must be distinguished from hard chancre of the lip. In chancre the ulcer is superficial on a hard cartilaginous base, and the sore may cicatrise. The submaxillary glands are enlarged from six to eight weeks after the first appearance of the sore, and secondary symptoms will appear. The age of the patient and the result of a mercurial course will often assist the diagnosis.

Termination.—If untreated, death occurs on an average from nine to eighteen months from the commencement of the illness.

Treatment.—Directly the nature of the disease is ascertained, excision should be performed. If the tumour be small, and involve a considerable thickness of the substance of the lip, a V-shaped incision should be used, the cut edges being united by hare-lip pins and twisted oiled suture. If the disease be extensive but superficial, the diseased part should be shaved off with curved scissors, the skin and mucous membrane being stitched together. When of greater extent, the disease must be completely extirpated and the gap closed by some plastic operation. In many cases the disease is cured by removal; in others, after a greater or less interval, it returns, either on the lip, or, more commonly, in the nearest glands. It is a proper proceeding to remove the disease as often as it comes back.

Tumours of the Parotid Region.—The parotid gland is not often affected, but may be the seat of cancer. More commonly the tissues in the vicinity of the gland are the seat of tumours, which may be fibrous, adenomatous, sarcomatous, enchondromatous, myxomatous, lipomatous, cystic, or carcinomatous. Compound growths are very common, as myxoma combined with fibroma, myxo-

ma with enchondroma, myxoma and carcinoma, cystoma and sarcoma, and lipoma with sarcoma. These growths often attain a large size; they are usually enclosed in a dense capsule, and are covered by the fascia of the parotid; frequently they send branches deeply behind the ramus of the lower jaw, involving the important adjacent blood vessels and nerves. The main point is to distinguish the malignant from the non-malignant. In the latter the tumour is well defined, movable, round, irregularly lobulated, skin is non-adherent, and its growth is slow. When malignant, the tumour is immobile, ill defined, the skin reddish purple, soon giving way; hæmorrhage occurs, growth is rapid, the adjacent glands quickly affected, and cachexia supervenes. Agnew writes: "If we assume that the time allotted to morbid growths of the parotid rarely extends beyond the fiftieth year of life, and if we divide this into three periods, namely, one between eighteen and twenty, one between twenty and thirty-five, and one between thirty-five and fifty, it will be found in most instances those growths which occur within the limits of the first period are myxoma, enchondroma, carcinoma—particularly of the soft variety, and cystoma. Those which appear in the course of the second period are sarcoma and fibroma; and those which arise within the third period are carcinoma of the scirrhus and epithelial varieties, and lipoma-sarcoma."

Treatment.—When non-malignant, extirpation with the knife. A very free external incision should be made over the posterior border of the tumour, and its capsule opened and the growth dissected out. Care must be taken of Steno's duct and the facial nerve; if the latter be cut it should be sutured with catgut. If the jugular vein and external carotid artery be closely adherent to the growth, and must necessarily be wounded in its removal, the best course appears to be to apply a ligature to each vessel above and below the growth, and then remove the tumour with the implicated portion of the vessels.

Diseases of the Jaws.

Abscess of the Gums (gumboil or parulis) usually occurs from the irritation of a decayed tooth. There is effusion of plastic matter at the apex of the fang in

the cavity formed by absorption of the alveolus and even of the fang itself. One part of this lymph is converted into pus, and the remainder forms a wall round it. Absorption of bone rapidly follows, the pus pointing at the side of the tooth, or perforating the socket, burrows in the soft tissues horizontally round the extremity of the fang, raising the gum within the mouth. In some cases the abscess occurs in the substance of the jaw. When the abscess is situated far back near the wisdom teeth, it often burrows between the bone and muscles, pointing at the angle of the jaw. When the abscess forms round the upper incisor teeth the matter insinuates itself between the periosteum and the hard palate, forcing the periosteum and mucous membrane downwards, so as to produce a swelling behind the incisor teeth; sometimes such an abscess evacuates itself within the nostrils. If these abscesses be not opened, necrosis is apt to occur. Alveolar abscesses, if they do not open within the mouth, may discharge their contents through the cheek, face, chin, or upper part of the neck. The agonising pain, extraordinary amount of and rapidity of swelling, together with the severe constitutional disturbance, are very remarkable.

Treatment.—Leeches to gum; opium and tincture of gelseminum, to relieve pain, and hot poultices or fomentation; an early incision with a scalpel or bistoury, down to the bone if fluctuation be present; if not, the tooth should be at once extracted notwithstanding the inflammation and swelling. On no account should one of these abscesses be allowed to burst through the cheek, or a most unsightly scar will result.

Hypertostosis consists in hypertrophy of the maxillæ, and, more or less, of other bones of the cranium and face. The cause is a blow, etc., and it generally commences in childhood. The nature of this disease is a periostitis leading to deposit of new bone, and expansion and filling up of the original osseous structure. The symptoms consist in projection of the parts affected, and displacement of neighbouring organs.

Treatment.—Iodine and iodide of iron internally. Gouging away bone, or removal of the superior maxilla if the disease be limited to one side.

Hypertrophy of the Gums is rare, but may be met with in both jaws, involving the whole of the alveolar arch. It is most

common in early life, and in persons of weak intellect.

Symptoms.—The gums are greatly enlarged, almost burying the teeth. The alveoli are expanded, the fibrous part of the gum much hypertrophied, and the papillæ of the mucous membrane large and vascular.

Treatment.—Remove the affected alveolus with cross-cutting forceps under an anæsthetic, and stop the hæmorrhage, which is profuse, with the actual cautery.

Necrosis of the Jaws.—This disease is most common in the lower jaw.

Causes.—Periostitis following dental irritation, injury, the action of specific poisons, as in necrosis of the jaw occurring in young children after the exanthemata as scarlet fever or smallpox, chemical irritants as phosphorus and mercury.

Symptoms.—1. Pain. 2. Pyrexia. 3. Part is swollen, red and hot. 4. Teeth are raised from their sockets and very tender on pressure. 5. Discharge of purulent matter from the mouth. Pus forms beneath the periosteum, thus giving rise to necrosis. Phosphorus necrosis leads to severe symptoms, and is remarkable for the pumice-like deposit of lowly organised new bone which is closely adherent to the sequestrum, although doubtless formed by the periosteum. In necrosis of the upper jaw no new bone is produced, the gap being permanent in adults, but sometimes filled up with fibrous tissue in children; in the lower jaw, however, considerable new bone is formed by the periosteum, but this is nearly always slowly reabsorbed. Sequestra should not be removed until completely loosened, a process which occupies from six weeks to three months.

Treatment.—If seen during the stage of periostitis, leeches, hot gargles, poultices, and free incision may prevent necrosis; if not, treat in the usual manner.

Epulis is a tumour arising from the periosteum and the border of the alveolus. It is either fibrous in nature, with fibro-plastic cells intermixed (simple epulis or ossifying sarcoma); or malignant in the form of a myeloid or epitheliomatous tumour, the latter being rare. The most usual cause is the irritation of stumps; it affects both jaws equally, and rarely occurs until adult age; at

this period the female sex is attacked more often than the male, in the proportion of 5 to 3. As it increases in size it loosens the teeth in its neighbourhood.

Simple Epulis is a firm, smooth and lobulated growth, covered by thickened gum; at first hard but soon becoming soft, ulcerating and discharging. It usually begins at the small tongue of gum between two contiguous teeth, and has its origin in the osteal membrane of alveolus.

Treatment consists in the removal of the growth, together with the portion of bone from which it springs, as it does not recur after complete removal. This operation can be performed when the growth is small, through the mouth, without an external incision. A tooth is drawn on each side of the epulis, a cut is then made with a saw through the two empty sockets, to the level of the base of the growth, the base of the jaw being preserved if possible. The epulis is then removed by the bone forceps or Hey's saw, a horizontal cut being made to connect the two longitudinal ones. Bleeding is arrested by means of a plug soaked in perchloride of iron, or the actual cautery.

Malignant Epulis is soft, purplish, grows rapidly, bleeds easily, and is liable to return after removal; it chiefly occurs in persons after the mid-period of life. The myeloid form contains fibrous tissue and giant cells, is soft and vascular, commonly springs from the interior of the alveolus, and in many cases is an outgrowth from a myeloid tumour of the interior of the jaw. It may contain bone or cysts.

Treatment.—Removal, as for simple epulis; but if large, a portion of the jaw must be excised.

Distension or Dropsy of the Antrum, Antracoele, consists in the accumulation of a viscid, or more commonly a serous, fluid containing cholesterin, within the cavity of the antrum. The fluid is contained in a cyst, which grows so as to fill the antral cavity, or bursts, allowing the fluid to escape into the antrum. The bony walls are expanded and the cheek swollen and prominent, but not painful; on pressure egg-shell crackling is produced.

Treatment.—As the bony wall is partially absorbed the distended membrane can be incised and the fluid

evacuated. The opening should be enlarged with curved scissors, and the antrum examined with a finger to detect any foreign body, as a tooth. Astringent and stimulant injections with a syringe are afterwards used, as sulphate of zinc or copper, or tincture of iodine.

Abscess or Empyema of the Antrum occurs from its lining membrane becoming inflamed, usually as the result of the irritation of decayed teeth, especially the first and second molars, but violent blows, or the entrance of foreign bodies, are occasional causes. The pus escapes partly into the nose when the patient blows it, and if he lie down the matter flows down the throat, giving rise to derangement of the stomach. Offensive odours are perceived by the patient, but not by those round him. The bone is not expanded, but if the pus cannot escape it will be, and the cheek swollen and tender, the integuments being thick and red. There are dull deep-seated pains of the head and neck, particularly in the teeth, nose, orbit, and forehead; the eye of the affected side is watery. The constitutional symptoms are generally severe. If the antrum be distended, egg-shell crackling will be elicited on pressure. When neglected the eyeball may protrude and vision be impaired; intracranial suppuration may also occur. Necrosis of the alveolar portion of the jaw or the nasal plate of the maxilla may happen as a rare event. The abscess sometimes bursts into the nose, perforates the cheek, or discharges at the neck of a tooth by burrowing along the fang.

Treatment.—By extracting the first molar tooth a dependent opening may be easily made with a trocar. It is necessary, however, to make a larger exit for the matter by separating the cheek from the gum, and making an aperture with a strong pair of scissors, antrum perforator, trocar, or gimlet, through the anterior wall. The instrument should be introduced a little upwards, and not horizontally. Professor Miculiez recommends that the antrum should be perforated from the interior fossa of the nose. For the operation a strong, double-edged stiletto-knife is used, fixed at an obtuse angle to a handle, and provided with a stop shoulder. This is passed along the floor of the nose until its point is just below the lower free edge

of the inferior turbinated bone, when it is made to pierce the antrum. The cavity can be easily washed out from this situation. This is best performed with a glass syringe or Eustachian catheter, by means of warm water and an astringent lotion, as sulphate of zinc or permanganate of potash. It is necessary to test the teeth with the ether spray, so that any which are diseased can be extracted. The bone will slowly assume its proper shape, but this may be assisted by the pressure of Hainsby's cheek compressor, or a double-headed roller.

Polypus of the Antrum is rare. It results from hypertrophy of the sub-mucous connective tissue. It may be fleshy or semi-gelatinous according to the amount of connective tissue or gland tissue entering into its composition. These polypi are very vascular, and occasionally malignant. They generally produce absorption of the bony wall, and project into the nose. A symptom sometimes present is a profuse and watery discharge, which constantly runs from the nostril of the affected side. Removal is similar to nasal polypi, but bleeding is free.

Odontomes are growths connected with the teeth, depending on an outgrowth of some of the dental tissue, as enamel, dentine, cementum or tooth bone.

Treatment.—When the growth is diagnosed as connected with a tooth, all neighbouring teeth which may be united to it should be extracted, and the bone need not be interfered with.

Tumours of the Upper Jaw are either simple or malignant. The benign growths may be fibrous, enchondromatous, or osseous. The malignant are sarcomatous or carcinomatous. The fibrous and sarcomatous are generally periosteal growths, the osseous and myeloid endosteal. The *fibrous* tumour springs from the interior of the antrum or some portion of the alveolus. Many of the fibrous growths apparently springing from the upper jaw really have their origin at the base of the skull, sphenoid or ethmoid bones. Its volume is generally moderate, but it may attain a considerable bulk. Middle-aged persons are its most frequent subjects. The *enchondromatous* tumour is rare, appears early in life, springs from the surface of the bone or antrum, and progresses externally or internally; by

ossification of a fibroma or enchondroma an osteoma will result. *Osteoma* may be met with as a hypertrophy of the whole or some portion of the bone, due to an increase in the cancellated structure of the bone. More commonly it occurs as an exostosis, which may spring from any portion of the bone, gradually increasing in volume and extent; the exostosis may be ivory or cancellated. The malignant growths are sarcomata and carcinomata. All kinds of *sarcomata* are met with—spindle-celled, myeloid, chondro-sarcoma, ossifying sarcoma, vascular and round-celled sarcomata. The carcinomatous tumours are of the epitheliomatous variety, and may be columnar or squamous. The spindle-celled sarcoma is of a yellower colour than the fibrous tumour, and has a softer consistence. Myeloid sarcoma occurs mostly before the age of twenty-five; it has a dark maroon colour. Chondro-sarcoma is very rapid in its growth, and extremely prone to return after removal, the secondary growths being round-celled. Round-celled sarcoma is of frequent occurrence. It takes its origin in most cases from the antrum, and may form a projection on the cheek without implicating the hard palate or nostril; or on the other hand it may quickly invade the nose, alveolus, or palate, and may be mistaken for a nasal polypus. Both upper jaws may be affected, or the upper and lower jaws. *Epithelioma*, when squamous, always commences in the gum or palate. Columnar epithelioma first attacks the antrum and fills it, and then spreads to the palate, or face. The epitheliomata and round-celled sarcoma grow very rapidly, are attended with severe pain, soon ulcerate and discharge, forming fungous masses, with often much hæmorrhage. Tumours of the upper jaw, as they increase in size, absorb and dilate the bony cavities, and soon by outward pressure cause a visible tumour, which appears generally at the anterior aspect of the upper jaw. The swelling will be smooth, of an oval or round shape, and overlapping the lower jaw. By pressure on adjacent bones various symptoms arise, the palate is depressed, the alveolus and teeth displaced, the orbit invaded; tears overflow from the nasal duct being obliterated, the eyeball protrudes and may be thrust out of its normal position, vision is dimmed, and if the pharynx

be attacked, respiration and swallowing will be affected.

Diagnosis.—From collections of fluid in the antrum a tumour is recognised by the history of the case, the absence of fluctuation, by the growth soon passing outside the wall of the antrum, and lastly, in doubtful cases, by an exploratory puncture, and sometimes the removal of a tooth. Heath writes: "It is advisable in all cases of tumour of the upper jaw in which the nature of the swelling is not obvious, to perforate the antrum beneath the cheek, before incising the skin of the face, and taking the necessary steps for the removal of the jaw." The fibrous, cartilaginous, and osseous tumours grow slowly, are painless and hard to the touch, and do not involve surrounding tissues or skin. Malignant are distinguished from simple growths by their greater rapidity of growth, by the lymphatic glands being enlarged and hard, by their soon implicating the nasal cavity and orbit, and by the skin being early involved. The fibro-sarcomatous and myeloid grow more rapidly than simple tumours, and are softer; they occasionally ulcerate, but do not form a fungus, though hæmorrhage is common. The round-celled sarcoma and epithelioma are excessively rapid in growth, and in invading surrounding tissues. Epithelioma is very soft, and apt to fungate; it is also often accompanied by neuralgic pains.

Treatment.—Excision of the tumour, together with all bone implicated.

Excision of the Superior Maxilla is required for the removal of tumours of the bone or antrum, for necrosis, and to give access to a naso-pharyngeal polypus.

Instruments required. — 1. Scalpels. 2. Artery forceps. 3. Torsion forceps. 4. Ligatures. 5. Retractors. 6. Tooth forceps. 7. Narrow saw. 8. Hey's saw. 9. Bone forceps. 10. Lion forceps. 11. Sequester forceps. 12. Gouges. 13. Chisel. 14. Gag. 15. Hare-lip pins. 16. Wire nippers. 17. Actual cautery. 18. Perchloride of iron. 19. Ice. 20. Sutures, silk, catgut, and wire. 21. Solution of chloride of zinc. 22. Lint and absorbent cotton. 23. Bandages. 24. Plaster. 25. Collodion. 26. Iodoform. 27. Mackintosh sheet. 28. Small sponges.

fastened to sticks. 29. Larger sponges. 30. Anæsthetic and inhaler.

Operation.—(1st Step.) The incision through the integuments may be either external or median, the latter being preferable. The former proceeds from the angle of the mouth in a curved direction, towards the malar bone. The latter follows the outline of the nose. The patient should be recumbent, chloroform is to be used as the anæsthetic, and a quantity of brandy and hot water, suited to the age of the patient, should shortly before the operation be injected into the colon. An incision is made commencing by division of the upper lip in the median line, and then carried along the nostril and up the side of the nose to the inner angle of the eye, and thence (if necessary) along the border of the lower lid to the zygoma.—(2nd Step.) A flap is then formed and thrown outwards, the margin of the orbit being exposed, and the cartilage of the nose is separated from the bone and reflected inwards.—(3rd Step.) The bony connexions are then to be divided. (*a*) That with the malar bone parallel to and immediately in front of the masseter muscle; this is notched with a narrow saw, and divided with the bone forceps; the cut will run into the spheno-maxillary fossa, and thus preserve the prominence of the cheek. If the malar bone be involved it should also be removed by dividing the zygomatic process, and the frontal process which unites it with the frontal bone. (*β*) That with the opposite bone along the centre of the hard palate. One of the incisor teeth must be extracted, and the soft palate divided from its attachment to the posterior nasal spine to just beyond the last molar tooth by a transverse incision, also the mucous membrane of the roof of the mouth should be incised along the median line. The palatal arch is then notched deeply with a saw, and divided by bone forceps passed into the nose and mouth, or may be completely divided with a narrow saw with a movable back, passed into the nostril, and kept horizontal, as recommended by Heath. (*γ*) Those formed by the nasal process at the inner angle of the orbit. This is severed by bone forceps inserted into the orbit and nose, or with a saw.—(4th Step.) Finally, with a pair of lion forceps, the loosened bone is drawn downwards

and forwards, and slightly twisted to break down the posterior attachments of the palate bone and pterygoid process of the sphenoid. The infra-orbital nerve should be divided with the scalpel behind the bone, whilst it is drawn forward. Hæmorrhage is stopped temporarily by the pressure of a sponge, which is in a few minutes removed, and the actual cautery applied at a black heat, if there be much oozing. The hollow left, if thought necessary, can be stuffed with lint, to which a thread is attached; but this soon becomes offensive, and is better omitted if possible. The cheek flaps are kept in position by silver sutures and a hare-lip pin through the lip. Free syringing by a nasal douche with antiseptic fluid is useful from the beginning. If not diseased, the floor of the orbit is to be preserved, by a transverse section of the jaw below the margin of the orbit; so also, if healthy, the alveolus and roof of the mouth should be retained, being separated from the body of the jaw by means of the saw or forceps (Heath). In cases of epithelioma, where diseased structures have been removed, Heath advises the application of chloride of zinc paste (chloride of zinc ʒj , flour ʒij or q.s., sedative solution of opium ʒj). This is applied on the end of a strip of lint to the doubtful part; the rest of the lint can be packed in and covered with a pledget of cotton wool so as to prevent the escape of the chloride of zinc into the mouth: it is advantageous to plug the posterior nostril on the affected side from the front with another strip of lint, to obviate the escape of the fluid into the throat. After three days the plugs are withdrawn, and the cavity syringed freely while the sloughs are separating. As a local antiseptic nothing is equal to powdered iodoform freely applied to the raw surfaces of the bone and soft parts.

The chief dangers of this operation are: 1. Hæmorrhage; 2. The entrance of blood into the air passages, causing suffocation; 3. Shock. It is a very successful operation.

Actinomyces of the Jaw consists in the development of a whitish tumour, starting from the posterior part of the alveolus, or from the spongy part of the bone, which distends and bursts through the osseous structure, generally in an out-

ward direction, destroying all the tissues in its course. The growth is composed of soft, pale, brain-like substance, dotted with numerous minute abscess-like cavities. Microscopically, the tumour consists of granulation tissue with peculiar yellow-like bodies about the size of a hempsced. Similar growths are met with in the tongue, pharynx, larynx, and mucous membrane of the stomach, and in adjoining lymphatic glands. These yellow bodies, or actinomyces (ray fungus), present a gland-like appearance, consisting of fine filaments radiating from a common centre, and club-shaped bodies, and are due to a vegetable fungus.

Cause.—Dr. Moosbrugger believes that in both animals and man infection takes place through inoculation of the fungus on a broken surface. The point of inoculation is either in the mouth, fauces, or pharynx, from abrasions due to hard food. Animals may also be infected by rubbing the skin of the neck, if abraded, against the manger. Barley is the suspected source of the organism. The human subject is not inoculated directly from the animal, or indirectly by eating its flesh, but through the use of grain as food, or by means of the inhalation of the spores of the organism. The place of inoculation may be carious teeth or damaged alveoli, thus extending to the periosteum or soft parts of the jaw; any abrasion of the mucous membrane or skin may be the starting-point of the disease.

Symptoms.—The fungus gives rise to the abundant formation of granulation tissue, which is so soft as to present fluctuation. The first symptom apparent is a hard, smooth, elastic (often painless) tumour, apparently seated under the periosteum. The swelling spreads to the soft parts around, either sooner or later, by direct extension, or through lymphatic channels, and forms nodular masses with white shreddy or granular foci. On incision, serum, containing little white granules, escapes, but no pus.

Treatment.—Incision and thorough scraping with a sharp spoon. Recovery is common. (Heath.)

Inflammation of the Lower Jaw may result from irritation of decayed teeth, leading in a few hours to the effusion of discoloured serum into the cancellous tissue, distending and forcing out the external plate of the jaw. By pressure

the effused fluid can be made to exude by the side of or through the hollow tooth. If relief be not given, plastic effusion takes place, resulting in the formation of a distinct tumour. If the tooth be removed this will disappear; but if not, may become organised into fibrous tissue, forming a fibrous tumour. (Heath.)

Tumours of the Lower Jaw.—These may be simple or malignant. The simple are cystic; fibrous, which are the most common, and may be periosteal or endosteal; osseous, either cancellated or ivory; or enchondromatous, which are rare. The malignant are either sarcomatous or carcinomatous. The sarcomatous may be spindle-celled, myeloid, chondrosarcoma, ossifying, or round-celled: the carcinomatous are columnar or squamous. Tumours are more common in the lower than the upper jaw, and may spring either from the alveolar margin, the interior of the bone, or its surfaces; they form large round growths projecting into the mouth and the side of the neck. The cystic growths vary in thickness, the walls being either membranous, fibrous, or osseous; in the latter case the shell of bone is formed by the periosteum, and on pressure gives rise to egg-shell crackling. They contain a thick, tenacious, yellowish fluid. Dentigerous cysts are met with, depending upon the presence of an undeveloped tooth in the jaw and the formation of a cyst round it. Multilocular cysts present themselves, originating in the growth of the epithelium of the gums, and in connection with columnar epithelioma, but are occasionally due to cystic formation in sarcomatous tumour.

Diagnosis.—The malignant are distinguished from the simple by their greater rapidity of growth, tendency to fungate within the mouth, implication of lymphatic glands, by the superjacent skin being soon involved, and by their soft elastic feel.

Treatment.—The cystic tumours are best treated by making an incision through the mucous membrane within the mouth without cutting the cheek, opening the cyst with a trephine or antrum perforator, and removing the thin outer wall freely with scissors or bone forceps. The other tumours require excision, including compound multilocular cysts occurring in adults; if small they can be removed from the mouth without an external incision.

Excision of the Inferior Maxilla may be partial or complete, according to the situation and extent of the tumour. The position of the patient and the instruments required are similar to those for excision of the upper jaw.

1. *Excision of a Portion of the Jaw from the Symphysis to the Angle.*—An incision is made extending along the lower border of the jaw from its angle nearly to the symphysis, and then carried vertically upwards to the base of but not through the lip. This will divide the facial artery, which must be at once tied or compressed with a needle and twisted suture. The flap is then dissected up from the tumour, and the mylo-hyoid and mucous membrane cautiously separated from the internal surface of the bone, using the handle of the knife as much as possible. A tooth having been extracted on each side of the growth, the bone is partially divided with a narrow saw on both sides of the tumour, and the division then completed with the bone forceps. The diseased bone is then removed by a careful application of the knife, keeping close in contact with the diseased part, and yet sufficiently distant to prevent any part of the growth remaining behind. All bleeding points are now tied. If the dental artery bleed, a fine Paquelin's cautery, or wooden plug, is thrust into the dental canal. The wound is then stitched up, dressed with iodoform, and a good, firm, fibrous cicatrix will be left.

2. *Excision of the Symphysis.*—A ligature is passed through the tip of the tongue and held by an assistant. A vertical incision is made in the median line, commencing at the margin of the lower lip and reaching the hyoid bone. Two flaps are formed and dissected back, the symphysis exposed, a tooth extracted on each side, and the diseased portion removed with the saw and bone forceps. The wound is closed by hare-lip pins and twisted sutures, to one of which the tongue is secured until it shall have contracted fresh adhesions, which usually takes place in five or six days.

3. *Resection of the Ramus and Half the Body.*—An incisor tooth being drawn, an incision is made commencing three-quarters of an inch in front of the posterior border of the ramus, on a level with the lobule of the ear, and is carried over the ramus to the angle,

and then along the lower border of the body to the symphysis, where it is met (if necessary) by a vertical incision from the margin of the lip. The flap is dissected up and the facial artery tied; the inner surface of the bone is then cleared. The saw is applied in the cavity of the incisor which has been extracted, and the section completed with the bone forceps. The jaw is then drawn downwards and forwards with the lion forceps in the left hand, and the mucous membrane and internal pterygoid divided. The temporal muscle is divided from the coronoid process with a pair of curved scissors or the knife, whilst the jaw is forcibly depressed. To obviate the danger of wounding the internal maxillary or other arteries, as well as to expedite the process of disarticulation, Gross recommends a flat bone elevator for cleaning the coronoid process and condyle. "The blade is slightly curved upon the flat, and is $3\frac{1}{4}$ inches in length, by $\frac{3}{8}$ inch in width, its thickness being about one line and a third. Its free extremity terminates in a convex edge, bevelled off in front and behind, so as to admit of being used for dividing the periosteum, or scraping the bone, as may be deemed necessary." The joint is opened from the front and disarticulation proceeded with. The jaw is forcibly depressed downwards, tearing through the external pterygoid muscle, and the capsular ligament with the remaining attachments severed by a few cautious touches of the knife kept close to the bone to avoid the internal maxillary artery. If the disease be not malignant, and does not involve the articulation, the ramus should be sawn across instead of being disarticulated. If the internal maxillary artery be wounded it must be ligatured, or the external carotid; any other branches that bleed are tied, a drainage tube inserted, the cavity sprinkled with iodoform, and the wound adjusted by hare-lip pins and a twisted suture. Afterwards glycerin. acid. carbolic. should be applied with a camel's-hair brush. Firm fibrous tissue is found in the place of the bone removed.

4. *Excision of the Entire Inferior Maxilla.*—The incision is made from one lobule of the ear down to the angle of the jaw, along the base to

the other angle, and then up to the lobule of the other ear. The bone is then cleaned, the jaw sawn through at the symphysis, and removed in two halves; the tongue being secured as before mentioned.

Spasmodic Closure of the Jaws results about the age of twenty from difficulty in the eruption of the wisdom teeth of the lower jaw, owing to want of room or malposition, setting up irritation, and thus producing spasm of the masseter and internal pterygoid muscles.

Treatment.—Administer chloroform, insert a gag, and remove the wisdom tooth or second molar. If this be not done persistent neuralgia may be troublesome, or abscesses may form burrowing widely about the angle of jaw and cheek. Some amount of reflex spasmodic closure of the jaw may occur in tonsillitis and irritation of the upper spinal nerves.

Immobility of the Jaw may be produced in various ways, and may exist in such a degree as to render the patient entirely unable to open his mouth or masticate his food. Gross writes: "The most common cause, according to my observation, is profuse ptyalism, followed by gangrene of the cheeks, lips, and jaw, and the formation of a firm, dense, unyielding inodular tissue, by which the lower jaw is closely and tightly pressed against the upper. Children of a delicate, strumous constitution, worn out by the conjoint influence of mercury and scarlatina, measles, or typhoid fever, are its most common victims; but I have also seen many examples of it in adults and elderly subjects. In the worst cases there is always extensive perforation of the cheeks, permitting the constant escape of saliva, and inducing the most disgusting disfigurement. Secondly, the affection may depend on injury, as a severe sprain or concussion, or arthritic inflammation, leading to a deposit of plastic matter, and the conversion of this substance into cellulofibrous, cartilaginous, or osseous tissue. Thirdly, the immobility is occasionally produced by a kind of osseous bridge extending from the lower to the upper jaw, or from the lower jaw to the temporal bone. Such an occurrence is, however, uncommon, and is chiefly met with in persons who have suffered from

chronic articular arthritis. Finally, immobility of the jaw may be caused by the pressure of a neighbouring tumour, especially if it occupy the parotid region, so as to make a direct impression upon the tempero-maxillary joint." If occurring in early life it is often followed by a stunted development of the jaw, exhibiting itself in marked shortening of the chin, and in an oblique direction of the front teeth. Inflammation of the masseter, and abscess under the temporal fascia, are occasional causes.

Treatment.—1. Removal of a wedge-shaped piece of bone *in front* of the cicatrices, to form a false joint. (Esmarch.) 2. Simple section of the bone from within the mouth by powerful forceps, a piece of gutta percha being interposed between the cut surfaces. (Rizzoli.) This operation is only useful when the cheek is unaffected. 3. Internal division of the cicatrices and the use of metal shields worn between the cheeks and gum. This method can be used when the entire thickness of the cheek is not affected.

Ankylosis of the Jaw may be fibrous or osseous.

Causes.—Disease of the tempero-maxillary articulation, as the result of scarlet fever, measles, rheumatoid arthritis.

Treatment.—For fibrous ankylosis, the adhesions may be broken down by screw wedges, or better, they may be divided after the method of Spanton, who passes a tenotomy knife into the tempero-maxillary joint on each side, immediately in front of the temporal artery, and then moves it freely round the condyle, dividing completely the external lateral ligament, and partially the insertion of the external pterygoid muscle, keeping the back of the knife towards the temporal, and measuring the depth of the incision, so as to avoid the middle meningeal artery. A

screw gag is then applied. Excision of the condyle has been performed, and Mears has proposed division of the ramus and excision of the condyle with the coronoid process and sigmoid notch, through the mouth. Humphrey, who first excised the condyle, exposed it by a curved incision from the side of the orbit across the zygoma to the ear, passing a little above the tempero-maxillary articulation; and by a second incision from the termination of the first directly upwards in front of the ear, across the zygoma again, avoiding the temporal artery. The neck of the condyle was cut through with a narrow saw. The operation was performed for rheumatoid arthritis. Mears' method is thus performed: a straight, sharp-pointed bistoury is introduced beneath the masseter muscle on a level with the last molar tooth of the lower jaw. Into the wound thus made the blade of an Adams' saw is passed, and the ramus sawn through. The periosteum, with the overlying masseter muscle, is raised by the periosteal elevator, and the wound thus enlarged. The insertion of the temporal muscle is now divided by a probe-pointed bistoury. The tissues on the inner surface are separated by the elevator, the bone seized by the lion forceps, and forcibly twisted outwards. If it yield at the neck of the condyle, this process is afterwards chiselled out. If necessary, the masseter may be divided. Hæmorrhage is controlled by packing the wound with sponges.

In osseous ankylosis, the following operation performed by Christopher Heath is the best, consisting in division of the ramus of the jaw beneath the masseter. A small incision is made within the mouth immediately above the last molar tooth, a steel director is passed to clear the way, and then an Adams' saw pushed beneath the masseter, and the ramus divided horizontally.

CHAPTER XXVIII.

INJURIES AND DISEASES OF THE THROAT AND MOUTH.—ASPHYXIA.—GASTROTOMY,
BRONCHOTOMY, AND LARYNGOSCOPY.

INJURIES of the mouth have been already treated of in a preceding chapter.

Injuries of the Throat.—These are usually the result of suicidal attempts. They are classified as follows:—

(a) *Wounds not extending to the Larynx or Œsophagus.*—From the large number of blood-vessels in the region of the neck, wounds are liable to be followed by copious hæmorrhage. If the common carotid artery, or internal jugular vein, be divided, the patient bleeds most rapidly to death, unless assistance be at hand. If any large vein in this region be wounded, there is a liability to the entrance of air in it, producing death immediately or within twenty-four hours. Should the pneumogastric or phrenic nerves be implicated, a fatal result, as a rule, takes place from some lung affection. The wound, when suicidal, is usually from left to right obliquely downwards, the greater portion of the wound being on the left side of the neck if the right hand have been used. Diffuse suppuration may occur in the loose cellular tissue beneath the platysma.

Treatment.—Digital pressure, and pressure forceps, quickly applied, are of service in securing time for the application of the necessary ligatures. Ligature all bleeding vessels, *both arteries and veins*, enlarging the wound if essential. If the wound be longitudinal its edges may be approximated with strips of plaster; if transverse or oblique, by sutures and position, the head being fixed close to the chest by means of bandages; drainage tubes are necessary, and an antiseptic dressing. In all cases of cut throat, the surgeon should, if possible, get the patient to *write* on a piece of paper who inflicted the injury, as this may be of great importance in subsequent judicial proceedings.

(b) *Wounds implicating the Pharynx, Larynx, or Trachea.*—1. Above the hyoid; may involve the depressor muscles of the jaw, elevator muscles of the hyoid, lingual and facial arteries, hypoglossal nerves and submaxillary glands

and ducts: such a wound will probably extend into the mouth, wounding the base of the tongue, and causing severe hæmorrhage. The tongue when divided may fall back over the larynx and produce asphyxia. The power of deglutition is lost.

2. In the thyro-hyoid space above the rima glottidis, laying open the pharynx, and dividing the superior thyroid vessels and superior laryngeal nerves. A wound in order to open the pharynx, if in front must be above the level of the top of the thyroid cartilage, if at the side above the level of the cricoid. There is danger of the blood which accumulates in the pharynx entering the trachea. Swallowing is difficult, œdema of the glottis may supervene, the epiglottis when severed may fall into the larynx, and emphysema may ensue. Frothy blood and air escape from the wound. The voice is lost while the edges of the wound gape, but if the orifice of the wound be closed by the hand it will be restored. This is the most common situation of the suicidal wound.

3. Below the glottis. The wound is generally transverse. The dangers are suffocation, from the blood which oozes from the external wound entering the trachea through the cut in the larynx, or detachment of one of the cartilages, and later on lung complications (bronchitis and pneumonia). The glottis loses its sensibility, and if the patient try to swallow liquid or solid food it is apt to enter the wind pipe and appear at the orifice of the wound. Cellulitis of the neck may follow, or œdema of the glottis, and in punctured wounds emphysema.

4. The trachea is rarely wounded in suicidal attempts; the dangers are similar to those of the larynx. The superior and inferior thyroid arteries, thyroid veins, superficial jugulars, thyroid body, and recurrent laryngeal nerves are liable to be injured.

(c) *Wounds extending into the Œsophagus* are very rare, owing to the depth at which it lies. Swallowing is impos-

sible, and saliva with any food taken at the mouth, appears at the wound. There is great risk of the food entering the air passages or the adjacent tissues.

Treatment. — Ligature all bleeding vessels, both arteries and veins (preferably with catgut) above and below the wound, which must be enlarged if necessary. When the bleeding consists of an oozing from small vessels it is best to insert a silver tube into the air passages, to plug the wound round this, and as soon as the hæmorrhage has ceased to remove the tube and plugs. If the hæmorrhage be profuse and not arrested by the deligation of such vessels as are within reach, aided by compression, the carotid artery should be tied. The patient is placed on his back and all blood-clot cleared from the glottis, artificial respiration being resorted to if necessary. If the tongue be divided it must be fixed by sutures passed through its substance; if the epiglottis be severed the portion must be removed. When the trachea is completely divided a stitch should be put in each side, and it is well to introduce a tracheotomy tube into the lower segment. The edges of the wound should be brought together by deep sutures, preferably of catgut or animal tissue, *except at the centre, which must be left open* for the escape of discharges, and attention must be paid to the position of the patient. The sufferer should be kept in a room heated to 80° Fahr., the air of which is kept warm and moist with steam, and a piece of muslin should be laid over the wound. Skilled nursing is a *sine qua non*. When granulation commences iodoform is useful, and the approximation of the edges by strapping or pads, the head being fixed in a suitable position. Wounds of the gullet may be sutured with chromicised catgut, or left alone, as seems most advisable. Bronchitis and pneumonia must be treated on ordinary medical principles, but lowering measures are ill borne. To administer food a flexible catheter or tube must be passed through the mouth or nose into the gullet; in order to see that the tube be not in the trachea a lighted candle should be placed opposite its end; if the tube be in the air passage, the candle will flicker or be extinguished. Through the tube a pint of beef tea, milk, or Liebig's extract, with two ounces of brandy and three eggs, are injected night and morning.

Nutrient enemata or suppositories must be employed if the feeding cause much distress, also if the pharynx be opened, to give it rest for a few days. If œdema glottidis arise tracheotomy is necessary. Spence advises that the upper part of the larynx should be fixed with a sharp hook and drawn upwards and forwards as nearly as possible into its natural position before proceeding with the operation. Von Langenbeck counsels the performance of tracheotomy in all cases in which speech or breathing is seriously impeded.

Sequelæ. — Aërial fistula, stricture, loss of voice and paralysis of the vocal cords where the latter or the inferior laryngeal nerves are injured.

Aërial Fistula most commonly occurs when a wound is situated in the thyroid space; the skin being doubled in and becoming adherent to the hyoid bone above and the thyroid cartilage below.

Treatment. — Erichsen recommends that the edges should be freely pared, and detached from the subjacent parts by the knife; a vertical incision is then to be made through the lower lip of the wound, splitting it downwards. Two points of suture are inserted into each side of the horizontal incisions, to bring the edges together, *whilst the vertical cut is left open* for the escape of the discharges and expired air. These fistulæ must not be closed if the rima glottidis have contracted and be insufficient for the purposes of respiration. Subsequent to suicidal wounds, although the vocal cords may remain intact, the lower portion of the larynx may undergo complete funnel-shaped obliteration.

Foreign Bodies in the Air Passages. —

Poulet gives the following list of foreign bodies most frequently met with in the air passages. (A) Animate—Leeches, worms, flies, hydatids, oyster fish. (B) Inanimate.—(a) Inorganic.—1. Solid regular: beads of glass, needles, pins, coins, buttons, bullets, pebbles. 2. Solid irregular: stones, nails, etc. 3. Hollow: rings of glass, tracheotomy tubes, whistles, mouth pieces, pipe bowls, pierced fruit stones, etc. (β) Organic—1. Regular: beans, nuts, grains of corn, coffee, water melons, dates, pills, peas. 2. Irregular: pieces of nuts, teeth, bones, fish bones, spikes, pieces of meat, food, cork. A foreign body when held in the

mouth may pass through the glottis, and enter the larynx during inspiration.

Situation.—The foreign body may either become impacted in some part of the air passages, or it may remain loose, and move up and down during the respiratory actions. It may be stopped at the entrance of the larynx, be lodged in one of the ventricles, or descend into one of the bronchi, more usually the right.

Symptoms.—Immediate. Feeling of suffocation, difficulty in breathing, spasmodic fits of coughing and retching, lividity of the countenance, eyeballs protruded, voice husky, and localised pain at the seat of the foreign body. After a time these symptoms may diminish, but are liable to return at intervals as often as the body is coughed up, and touches the side of the larynx, thus producing spasm of the glottis, which may prove fatal at any instant. An abundant expectoration of frothy mucus follows these attacks. On auscultation, if loose, the body may be heard moving with the respired air. If impacted in the larynx, the inspiratory sound will be very rough, whistling, and stridulous; if fixed in the bronchus, the breath sounds will be weakened or wanting on the affected side, and puerile on the unaffected. *On percussion both sides will be resonant.* If the substance be small and has reached one of the subdivisions of the bronchus, air will be unable to enter that lobe of the lung.

Secondary effects.—After a day or two, or at a later period, inflammatory symptoms arise, as bronchitis, pneumonia, or pleurisy, when the extraneous substance is retained in a bronchus. If in the larynx, inflammation of the mucous membrane ensues, which may be limited, or spread producing a diffuse laryngitis. Congestion, induration, and ulceration may result. Occasionally abscesses form in the lung, with the expectoration of blood and pus. Sometimes phthisis and marasmus supervene. These various changes generally occur at the site of the foreign body, but occasionally remote parts are affected. In some cases the body may be impacted in a bronchus even for years without producing any symptoms.

Diagnosis.—The two points to be considered are: 1st. Is a foreign body present? 2nd. Where is it situated? The

first is made out by the story of the patient or bystanders, by the occurrence of symptoms abruptly in a healthy individual, by the subjective symptoms as to localised pain, and by the various auscultatory symptoms. The patient should swallow some water to see if deglutition be natural and painless, and an œsophageal sound may be cautiously passed. The situation of the foreign body is determined by the following symptoms: if in the larynx, pain in this region, paroxysms of suffocation, harshness of voice or aphonia, nausea, laboured inspiration and expiration, with a valvular or stridulous bruit. In cases of doubt the laryngoscope will give valuable evidence. When in the trachea, if the body be fixed laryngoscopic examination is often necessary, as the symptoms are not well marked; if the body be movable, paroxysms of suffocation with asphyxial symptoms recur at intervals, cough, flapping bruit, and sensation of movement perceived by the patient. In the bronchi the auscultatory signs are the best guide. After tracheotomy the position of the body can be ascertained by the tracheal speculum.

Treatment.—Examine the larynx with the laryngoscope, using a 20 per cent. solution of cocaine to secure anæsthesia, and if the substance be detected remove it with long curved forceps (Mackenzie's or Durham's), or a hook. Should this fail, perform tracheotomy *at once*, even if the symptoms be not urgent; in adults, where the body is in the larynx, laryngotomy may be employed. The patient should then be inverted, and if the substance do not then escape, the wound must be kept open by a dilator, blunt hooks, or ligatures, until it is coughed up, or an endeavour may be made to remove it with trachea forceps, hooks, etc. Antiphlogistic treatment must be employed, and the wound afterwards closed. Spence writes: "If a foreign body be lying loose in the trachea, and if we expect it to be ejected by the natural expulsive efforts when the tracheal opening is made, we should give no chloroform. In cases of impacted foreign bodies, where we require to use instruments for their extraction, chloroform is of great service." He counsels in all cases the introduction of a tracheotomy tube into the trachea *after*

the extraction of the foreign body, and keeping it there from four to six hours until the wound is glazed, which should then be closed by strips of plaster and not by sutures. Sands points out that "in adults the bifurcation of the trachea and the orifice of each primary bronchus can be reached by the forefinger introduced through an ordinary tracheotomy wound, and that when desirable the little finger can be passed upwards into the larynx, so as to detect either a foreign body or a morbid growth." If the body be lodged in the larynx, and the surgeon not able to remove it, Dr. Lifferts recommends that the thyro-hyoid membrane should be divided, and the body removed through this opening; another course which may be pursued is to divide the thyroid cartilage in the middle line, and fully expose the interior of the larynx (thyrotomy). The latter operation is thus performed: the patient is anæsthetised, and a free incision made along the anterior border of the thyroid cartilage and the crico-thyroid membrane; all bleeding having ceased, the crico-thyroid membrane is opened, and then the thyroid cartilage divided in the middle line up to within a quarter of an inch of the top, which is left untouched. A 10 to 20 per cent. solution of cocaine is painted over the mucous membrane to lessen its excitability.

Scalds of the Mouth and Pharynx are of most frequent occurrence in young children, from drinking from the spout of a kettle containing hot water; in adults the commonest causes are breathing steam in boiler accidents, or gas in explosions.

Symptoms.—1. The mouth, tongue, and fauces are red, and here and there covered with vesicles. 2. Intense burning pain. 3. Difficulty in swallowing. 4. Dyspnœa which gradually increases. 5. Great restlessness and anxiety. 6. Acute laryngitis and œdema glottidis quickly ensue, followed, if relief be not afforded, by death from spasm or inflammation of the air passages (laryngitis and broncho-pneumonia).

Prognosis is very grave; death may supervene quickly from shock, or spasm of the glottis; in other cases a fatal result happens more slowly from broncho-pneumonia: if the patient be tided over these dangers, convalescence is very slow.

Treatment.—Rest in bed, which should be surrounded by curtains, and the air kept moist by steam from a kettle. Olive oil as a drink and ice constantly sucked are very grateful to the patient. Leeches applied to the lower part of the neck. Hot sponges round the neck. The most serviceable drugs are calomel gr. ij to iv every hour, vin. antimon. mij to iiij every quarter of an hour, and aconite $\text{m}\frac{1}{2}$ every quarter of an hour. Scarification of the glottis with a sharp-pointed bistoury guarded to within its terminal half-inch by plaster, is often of great advantage. If the dyspnœa be severe, tracheotomy should be performed under an anæsthetic. In these cases I prefer performing tracheotomy *immediately*, without waiting for symptoms of dyspnœa to arise, as I am thoroughly convinced from experience that the sooner this operation is performed, the greater is the chance of a successful result.

Asphyxia or Apnœa.—Causes. 1. Physical impediment to the entrance of air. (a) Accidental, external: pressure on the chest preventing expansion, pressure on the throat, smothering, paralysis of the respiratory muscles, and penetrating wounds of the chest admitting air. Internal: foreign bodies in the larynx or fauces, and constriction from a caustic fluid. (b) Disease. Pressure by an aneurism or tumour on the trachea; œdema glottidis; obstruction of the air passages by a tumour, accumulated mucus, etc.; apoplexy at the base of the brain or medulla oblongata, causing paralysis of the pneumogastric. 2. Drowning. 3. Absence of oxygen, nitrogen or some other harmless gas being inhaled. 4. Inhalation of poisonous gases, as sulphuretted hydrogen, coal gas, etc. (Harley.)

In drowning, life is very rapidly destroyed; after five minutes' complete submersion, treatment is rarely successful, though if the patient be in a state of syncope whilst submerged, recovery may take place at a longer interval.

Symptoms.—1. Dyspnœa. 2. Pulse at first quickened, then slow and feeble, and finally lost at the wrist. 3. Heart sounds are heard after the pulse is lost at the wrist, but cease ten minutes after the first interruption of respiration. 4. Cerebral symptoms, as fulness in the head, giddiness, singing in the ears,

flashes of light in the eye, voluptuous dreams, insensibility and convulsions.

Appearances.—Blueness of the lips, anxious countenance, projection of the eyeballs, distension of the vessels of head, face, and neck; frothy mucus which may be tinged with blood round the lips; involuntary passage of feces and urine, and emission of semen.

Post-mortem appearances depend on the cause of the asphyxia, and after twelve hours the external signs are not characteristic.

External.—Lividity of the lips, bloody froth oozing from the nose and mouth, tongue livid and swollen, often projecting beyond the teeth and sometimes indented or lacerated by these, eyes half open, eyelids livid and pupils dilated, face pale and calm, with a placid expression. Rigor mortis sets in early, and the body is often stiffened in the convulsed or distorted attitude present at the time of death.

In death from drowning, the fingers and surface of the body occasionally present abrasions, and gravel, sand, mud, weeds, etc., may be found locked in the hands or nails. If the body have remained long in the water the skin of the soles and palms of the hands is white and soddened. In death from hanging the mark of the cord is visible, varying in depth, and with or without ecchymosis, according to the amount of violence. After death from strangulation the marks of the cord or digital pressure are apparent; the hyoid bone may be fractured, or the cartilages of the larynx dislocated.

Internal Appearances.—The right side of the heart is full of dark blood, the left side empty or containing dark blood. The blood throughout the body has a venous tint. The portal system is much engorged. The lungs are more or less congested, often increased in volume, and completely fill the chest. The cerebral vessels are not, as a rule, unusually full. In drowning the characteristic internal appearances are water in the stomach and mucous froth in the air passages and lungs. In strangulation the lining membrane of the windpipe and larynx is reddened from congestion, and may be of a dark red or livid colour. There is rupture of the superficial air cells of the lungs, producing patches of

emphysema. Effusions of blood in the substance of the lungs. In suffocation the skin of the face, neck, and shoulders presents dotted ecchymoses. The lungs exhibit small ecchymosed spots or patches beneath the pleura (punctiform or subpleural ecchymoses).

Treatment.—1. Remove from the neck and chest all articles of clothing. 2. Wipe the body dry and cover with dry clothes. 3. Clear the nostrils, mouth, and nose of mucus, and pull forward the tongue. 4. Place the body at full length, with the face downwards, the forehead resting on the arm, to allow all fluids to flow readily from the mouth. If satisfactory breathing commence, use treatment described below to restore warmth. If the breathing be slight or absent, at once endeavour to restore it by: 5. Ammonia to the nostrils. 6. Artificial respiration by either Silvester's, Howard's, or Marshall Hall's method. 7. To promote warmth and circulation: Commence rubbing the limbs upwards with firm grasping pressure, using handkerchiefs or hot flannels. Apply warmth by the warm bath or vapour bath. Heat by means of hot-water bottles or bladders of hot water, heated bricks or flat irons wrapped in flannel, etc., to the pit of the stomach, the armpits, between the thighs, and to the soles of the feet. Directly the patient can swallow, a little hot brandy and water should be administered. The patient should be kept in bed for some days. The diet should consist of warm milk, tea, coffee, and beef tea. It is necessary to see that there is no crowding of spectators round the patient, and that he has a free supply of air.

Silvester's Method of Artificial Respiration.—Place the body on its back, with the head slightly raised; the surgeon stands at the patient's head, grasps his arms at the elbow, and draws them steadily upwards until the hands meet above the head, and retains them in this position for two seconds. Then the elbows are slowly replaced at the side and pressed inwards for two seconds. These alternate movements of the arm are repeated fifteen times a minute until a spontaneous effort to breathe is made.

Marshall Hall's Method is inferior to Silvester's. Lay the patient on his face, one arm being folded under his forehead

and the chest raised on a folded coat. Now turn the patient on his side, whilst an assistant keeps the head forward and the mouth open. When two seconds have elapsed turn the body again face downwards for another two seconds, then raise on to the side again. Repeat these movements fifteen times a minute.

Howard's, or the Direct Method.—Rule 1. *For ejection and drainage of fluid from the stomach and lungs.* Instantly place the patient with the face downwards. A hard roll of clothing beneath the pit of the stomach, making that the highest point, the mouth the lowest. Forehead resting on the arm or wrist, keeping the mouth from the ground. With the hands well spread on the patient's back above the roll of clothing, throw upon it your whole weight with a forward motion, and keep up the pressure for three seconds, ending the pressure with a push, which will help to jerk you back to your upright position. Repeat this once or twice, and then quickly proceed with—

Rule 2. *To make the patient breathe.* Turn the body face upwards, with the roll of clothing under the back and the shoulders slightly drooping over it. Bend the head backwards and downwards, putting the neck well on the stretch. Place the hands of the patient on the top of the head (one twist of a handkerchief round the wrists will keep them there). Now kneel astride the patient's hips, grasp the front part of the chest on both sides of the pit of the stomach, your thumbs pointing to the patient's chin. Fix your elbows firmly, make them one with your sides and hips; and then, firmly pressing the patient's sides together and using your knees as a pivot, throw yourself slowly forward for two seconds until your face almost touches your patient's and your whole weight presses on his chest. End this pressure with a short push, which suddenly jerks you back again to the upright kneeling position. Rest two seconds and repeat fifteen times a minute.

Other means of artificial respiration are the bellows, and the split sheet. Inflation of the lungs with oxygen is of much value.

The treatment must be persevered in for at least two hours. In cases of hanging, bleeding from the jugular vein should

be conjoined. If respiration cannot be set up through the mouth or nose, laryngotomy or tracheotomy must be performed, and the lungs inflated through the opening thus made. A most valuable aid to artificial respiration is faradisation of the phrenic nerve; one reophore is placed on the right phrenic nerve in the neck, and the other during inspiration on the right side of the chest at the level of the sixth intercostal space. The current must be strong enough to cause contraction of the muscles of the ball of the thumb, and the skin thoroughly moistened with salt and water. Gross writes: "No writer, as far as my information extends, has made any mention, in connection with the resuscitation of asphyxiated persons, of what I conceive to be, next to artificial respiration, the most valuable element in the treatment of this class of affections. I allude to flagellation, or slapping of the surface, either with the bare hands, a bundle of thin switches, a lash made of thin pieces of cord, or the fringed end of a towel, used either dry or wet with cold water, the latter mode being particularly serviceable in warm weather. I know of nothing that is so powerful an excitant of the vaso-motor system of nerves and of the cerebro-spinal axis as this."

After-treatment.—1. Give some warm nutriment, to which a small quantity of stimulant is added; beef tea, chicken broth, coffee or tea with brandy, etc. 2. Place the patient in a well-aired bed, with hot bottles to his feet, and encourage sleep. 3. On no account allow the patient to be moved for some hours, and have him watched during sleep in case secondary apnœa may supervene. If this occur, gentle friction and artificial respiration are requisite. Give volatile stimulants, as sp. ammon. arom. and sp. æth. nitros.

Injuries of the Pharynx and Œsophagus.

—*Foreign Bodies.*—Poulet gives the following list of foreign bodies which have been met with in the pharynx and œsophagus, in their order of frequency 1. Animate bodies: leeches, fishes, salamanders, mice, eels, frogs. 2. Inanimate. (a) Organic: bone, fish bones, pieces of meat, fruits and kernels, pieces of wood and grain, lung, egg, cork, spindle, dominoes, violin pegs, comfits, cake, flute stopper, teeth. (b) Inorganic: pins, needles, coins, flat and round bodies

(child's saucer, medals), sets of teeth or portions of one, knives, seissors, compass, razor, blades, forks, spoons, rings, buckles, buttons, pebbles, glass vials, pieces of glass, stone, brick, thermometers, bullets, bars, pieces of pots, eye-glasses, butcher's hone, feathers, iron file, brass chains, lead seals, tubes and pipes, diamonds, table roller, sucking bottle, beads, sounds, plaster, padlocks, fish hooks. When the body is small and sharp-pointed, as a pin, needle, or fish bone, it is usually entangled in the folds of mucous membrane stretching from the root of the tongue to the epiglottis, behind the tonsil, or beside the hyoid bone. If large, as a coin or lump of meat, it is commonly arrested at the normal constrictions which exist at the commencement of the œsophagus behind the cricoid cartilage; secondly, and more rarely, at the level of the first rib; and thirdly, at the end where it passes through the diaphragm.

Symptoms.—If of large size, and impacted at the end of the pharynx or commencement of the œsophagus, a prominent symptom is difficulty of breathing, from spasm of the glottis, which, if unrelieved, will soon terminate fatally. There is nearly always a feeling of suffocation, beginning suddenly, soreness behind the sternum, retching, difficulty in swallowing solids, cough from spasm of the glottis and laryngeal irritation, harshness of voice, turgid and congested face, and sweating, with prostration. Spasm and convulsions are occasionally met with. When the obstruction is complete, there is a constant expectoration of saliva and mucus. Pain exists when the canal is distended by a foreign body, or irritated by its shape: it may be fixed, localised, and increased on movement when produced by small substances, or dull and diffuse if by large. Pain is often absent, but may be the only symptom. If the body be so large as to press against the posterior wall of the trachea, the sense of suffocation is very urgent, the face is livid, the patient greatly agitated, struggles wildly, and the head is thrown back, which increases the danger.

Results.—If not treated, the primary symptoms may persist; rarely the foreign body becomes eneysted; thirdly, œsophagitis, pericœsophagitis, ulceration and perforation of the trachea, bronchi, vessels, pleura or pericardium, and ab-

cesses may supervene. It may migrate, if sharp, as a pin, and appear under the skin or enter neighbouring cavities. Hæmorrhage, inanition, or marasmus may prove fatal. If the foreign body be removed, the symptoms generally disappear, but œsophagitis from irritation of the mucous membrane may occur. This is known by symptoms of pain, dysphagia, and fever. The œsophagitis generally passes off in two or three days, but in some cases inflammation arises in the cellular tissue round the œsophagus (peri-œsophagitis), terminating in the formation of pus, the abscess opening into the gullet, trachea, pleura, or mediastinum. Abscess, if following œsophagitis, is circumscribed in the walls of the œsophagus, and opens into that canal; when following peri-œsophagitis the abscess may burst into the œsophagus, open externally, or into a neighbouring organ.

Diagnosis is made by the finger, laryngoscope, or metallic bougie. It is to be noticed that although the foreign body may have been removed, the irritation caused by it may remain for some time, inducing the impression in the mind of the patient that he is not relieved.

Treatment.—If large, and occupying the pharynx, it may be hooked up by means of the fingers or forceps. If asphyxia be present, laryngotomy should be at once performed in adults (in urgent cases the surgeon should use a penknife); in children tracheotomy is necessary, followed by artificial respiration, which is maintained until the substance is removed. If small and pointed, an expanding horsehair probang is useful, or, the position being ascertained by the finger, laryngoscopic mirror, or œsophagoscope, extraction can be performed with crocodile forceps. When the body is fixed, its position should be ascertained by Bryant's œsophageal bougie with metal olivary end: it must be remembered that if a foreign body have been impacted for some time, it may be so completely buried in the walls of the gullet as to escape detection by a bougie. Poulet writes:—1. *Extraction* is indicated in all cases in which the body may be withdrawn, either with the aid of prehensile instruments, or instruments which act from below. 2. *Propulsion* (i.e. pushing the body downwards into the stomach) is indicated in foreign bodies of the cervical region when they

are regular and cannot be extracted, whether large or small, and especially when they are capable of being digested by the intestinal juices. 3. On the contrary, œsophagotomy must be performed whenever the foreign body cannot be extracted, and is large, irregular, and of such a nature as to lead to secondary symptoms if it should pass into the stomach. 4. When the foreign body is situated in the thoracic region of the œsophagus, we should endeavour to extract it without violence by all possible means. 5. If extraction fail, nothing remains but propulsion or the expectant plan. Despite the gravity of the situation, the preference should be given to propulsion.

Extractive instruments are divided into: 1. Prehensors, or instruments which act on foreign bodies without having to be passed beyond the point at which it is arrested; 2. Conductors, which have to be passed below the foreign body, and act from below upwards; 3. Dilators.

1. *Prehensors*.—Fingers, forceps curved at appropriate angles, long and narrow. Flexible forceps are sometimes of service. Disjointed forceps, applied like midwifery forceps, are very useful.

2. *Hooks*, as Petit's. Graefe's basket, modified by Dupuytren and Charrière, is very serviceable in extracting coins, pieces of bone, false teeth, etc. Collins' lever extractor is the most perfect type of conductor, and a most valuable instrument. Expanding horsehair probangs. Rings of metal or loops of hair attached to whalebone are used when the body is small.

3. *Dilators*.—Sponges attached to whalebone, or incased in the hollow of a bulb at the end of a sound, which bulb can be opened at will. Béniqué's instrument consists of an elastic sound with a bladder of goldbeater's skin about half an inch from the end, which can be inflated when the instrument has passed the foreign body. To this a cup should be added which closes on passing down and opens in coming up. Above the foreign body another bladder of larger dimensions is passed, which can be filled with water to dilate the œsophagus after the manner of Barnes' bags. In performing extraction it is not advisable to anaesthetise the patient, but his arms should be fixed to the side by a towel

wrapped round the chest and upper limbs, and the jaw kept open with a gag. For propulsion, sponge probangs or metal-headed sounds may be used, and care must be taken not to use overmuch force, and to be certain the propeller has pushed the body into the stomach, as it is apt to be caught at the cardiac orifice. If the substance be hard and indigestible, and have reached the stomach, should no irritation ensue, the patient must be kept in bed, take plenty of constipating food, as rice, cheese, hard boiled eggs, potatoes, etc., *but neither purgatives nor opiates are to be used*. Should irritation arise, a probang is to be passed to ascertain its position, and extraction attempted by a "coin catcher." If impacted, and symptoms of inflammation arise, perform gastrotomy and remove it.

Poulet writes: 1. Operation of gastrotomy is indicated whenever the intensity of the primary or secondary symptoms produced by the arrest of the foreign body threaten the health of the patient. It may be either primary or secondary. 2. The operation is also indicated when the foreign body projects externally; either immediately, if the foreign body be dangerous from its shape, or if symptoms be very grave, or a little later if the preceding conditions be absent, so as to permit the formation of peritoneal adhesions.

Æsophagotomy.—The left side of the œsophagus is more accessible than the right. The patient being anaesthetised, he is placed on his back, with the head and neck extended, and his face turned to the side opposite that on which the incision is made.—(1st Step.) An incision three to five inches long is made a little to the inner side of the internal border of the left sterno-mastoid, extending from the upper border of the thyroid cartilage to nearly the sterno-clavicular articulation. This will divide the skin, superficial fascia, platysma myoides, and deep fascia. If the anterior or external jugular veins be seen, they must be drawn aside or divided between two ligatures. The sterno-mastoid will be exposed, and is to be drawn outwards with a retractor.—(2nd Step.) The outer border of the sterno-thyroid is then sought for, and the cervical fascia divided along that border.—(3rd Step.) The omo-hyoid is drawn outwards or cut

through, and the carotid and internal jugular, in their sheath, separated from the tracheal muscles with a blunt director or the finger, all these structures being drawn outwards with a large retractor.—(4th Step.) The trachea and overlying structures are drawn inwards to the right, exposing the œsophagus and lower part of the pharynx.—(5th Step.) A probang, long curved forceps, or, better still, Vacca's œsophageal sound, is then introduced through the mouth, in order that the œsophagus may be distended at the bottom of the wound.—(6th Step.) The œsophageal wall is then raised with forceps and punctured, the incision being extended by blunt-pointed scissors or bistoury, until a sufficient opening is made to admit the finger to act as a guide to the forceps. The foreign body is then extracted. Care must be taken of the inferior thyroid artery—which crosses the line of incision deeply at the upper part, behind the carotid sheath—and the recurrent laryngeal nerve, which lies in the groove between the trachea and the œsophagus. The superior and middle thyroid veins may have to be ligatured and divided.

After the operation the patient must be nourished by food conveyed either through a small tube passed through the mouth and retained, or by nutrient enemata, or suppositories. No sutures are required, and the external wound must not be sewn up closely.

Rupture of the Œsophagus may occur from stricture, malignant disease, or in violent vomiting. The symptoms are acute pain, collapse, hæmorrhage, swelling with crepitation and emphysema. Swallowing is difficult or impossible.

Sequelæ.—Abscess in the mediastinum, pleurisy, etc.

Treatment.—Feed by the rectum.

Diseases of the Mouth and Throat.

Tongue-tie.—The frænum of the tongue is sometimes shorter than it ought to be, impeding the motions of that organ, and interfering with suckling. Mothers frequently bring children, who they suppose are tongue-tied, to the surgeon, without this defect being present at all. If the child can protrude the tip of the tongue beyond its gums there is no occasion to interfere.

Treatment.—This consists in turning upwards the apex of the tongue with the

middle and index fingers, snipping the tight band for an eighth of an inch with a pair of round pointed scissors, and rupturing the remaining portion of it as far as may be necessary, by pushing the tongue backwards with the finger. The scissors must be directed downwards to avoid the ranine arteries, and kept near the jaw. Bransby Cooper has recorded two cases in which the frænum was absent, allowing the organ to fall back into the fauces, thus producing suffocation.

Macro-glossia, Prolapsus Lingue, or Overgrowth of the Tongue, is a rare affection. It is congenital, and may be conjoined with epilepsy. The tongue is infiltrated with white cells enclosed in delicate retiform tissue, forming a lymphoid tissue. The connective tissue is also increased. The lymph vessels are dilated into cavernous spaces, containing clear lymph, and the blood-vessels are enlarged. This condition predisposes the tongue to attacks of glossitis under slight irritation. This disease is in some cases associated with a hygroma or cystic tumour at one side of the neck, which is probably due to the same cause, namely, lymphatic obstruction.

Symptoms.—The tongue is enlarged in all its dimensions, but one side may be affected more than the other; it may be so large as to protrude considerably beyond the teeth, and even far over the chin. From exposure the surface of the protruded part becomes rough, callous, and of a dark colour, and in places ulcerated. By the pressure of the large mass the alveolar border and lower front teeth are forced forward in a horizontal direction, and the jaw may even be dislocated. Saliva constantly dribbles from the mouth.

Treatment.—Pressure on the chin by an elastic bandage, or the use of a large teat to suckle the child. Strapping the tongue with strips of isinglass plaster. Antistrumous remedies, as cod-liver oil, iodides of iron and potassium, etc. Gross recommends a lotion of pyroligneous acid, in the proportion of one drachm to the ounce of water. The best and most reliable plan is excision of the exuberant structures sufficiently to allow of the tongue being retained within the mouth, by the knife, ligature, or écraseur, as for cancer.

Acute Glossitis or inflammation of the tongue generally results from an abuse

of mercury, scalding or corrosive fluids, the stings of insects, and occasionally follows the specific fevers or infection with septic matter; it is very rarely idiopathic.

Symptoms.—The tongue enlarges suddenly and is swollen with a red mammillated appearance. It almost completely fills the mouth, impeding deglutition and articulation, and threatening to suffocate the patient. There is profuse dribbling of saliva, and the tongue may protrude beyond the teeth. The parts are very tender, œdematous, and may become gangrenous. The disease may terminate in resolution or in suppuration.

Treatment.—In mild cases a free purge followed by salines with antimony. The patient should suck ice freely. Astringent gargles, as tannin, iron, or chlorate of potash, are useful. Counter irritation to the neck. If of an erysipelatous nature the tongue may be painted with a weak solution of iodine, or nitrate of silver. In septic cases quinine or perchloride of iron should be administered internally. In severe cases a free incision should be made on each side of the raphe; care must be taken of the ranine arteries, which are often pushed upwards so as to lie near the dorsum; the knife should be guarded by lint or sticking plaster to within half an inch of its extremity, and the incisions be made half an inch from the middle line. The bleeding is profuse but is advantageous. If the dyspnœa be urgent, laryngotomy or tracheotomy is to be performed.

Other diseases of the Tongue are abscess and nævus, which are treated on the usual principles. Hydatid and sebaceous cysts are occasionally met with. Various tumours, as papilloma, lipoma, fibroma, enchondroma, keloid, and sarcoma.

Ulcers of the Tongue are divided into: 1. Irritable; 2. Dyspeptic; 3. Syphilitic; 4. Cancerous.

1. *Irritable.*—These are caused by the irritation of rough teeth, spirit drinking, or in smokers from the stem of a pipe, etc. They also affect the lips. The ulcers are extremely painful, covered with greyish slough, interfere with mastication, are prone to take on a phagedenic process, and are accompanied with disturbances of the digestive organs. Unlike cancerous ulcers, they are often multiple, and the edges are not hard.

Treatment.—Touch the ulcers with nitrate of silver, remove or file down the rough edges of the teeth, and correct dyspepsia. Smoking and alcohol must be avoided. Chlorate of potash gargle. Subnitrate of bismuth mixed to a cream with glycerine, and applied to the ulcers, is a useful application.

2. *Dyspeptic* often accompany or follow psoriasis, and usually occupy the middle of the tongue. The tongue has several rhagades, fissures, or cracks in other parts. The edges of the sores are not hard.

Treatment.—Similar to the preceding, and arsenic internally.

3. *Syphilitic.*—This ulcer is large, with a sloughing base, and hard raised edges; it is most commonly situated on the back or sides of the tongue. It resembles the cancerous ulcer, but the edges are not so hard, the submaxillary glands are not affected as a rule, though those at the back of the neck beneath the trapezius may be large and swollen.

Treatment.—That of syphilis, on which it depends.

4. *Cancerous* (*vide* Cancer of the Tongue).

Psoriasis.—The tongue is indurated with cracks and fissures on its surface, which is unusually smooth, and looks as if the papillæ had been removed. Here and there are studded broad patches of a white colour, varying in extent. This is frequently syphilitic in origin, and may be accompanied by psoriasis in other parts; but may be non-syphilitic, and due to any irritation.

Leuco-plakia, Ichthyosis, Keratosis, Tylosis, consists in the tongue being covered with a smooth, bluish-white appearance, having a tessellated arrangement, and at the same time the papillæ are absent (tessellated ichthyosis). In other cases the papillæ are enlarged and covered with a horny epithelium (papillomatous ichthyosis). A third variety consists in the tongue being covered with a whitish or yellowish raised plaque, resembling chamois leather (raised plaque ichthyosis). All these changes depend on chronic superficial glossitis, followed by thickening of the epithelium, with sclerosing of the underlying tissues. Smoking and local irritation from decayed teeth are the most common causes. These changes in the epithelial covering of the tongue are

very important, as they are often the precursors of epithelioma.

Treatment.—The patient must give up smoking, spirits, and condiments. Arsenic, pil. hydrarg., tonics, and a milk diet. Locally, chlorate of potash, or bicarbonate of soda. Painting the part with salicylic acid and collodion. Using a 20 per cent. solution of cocaine to lessen the sensibility of the part, and destroying any ulcerated spot with nitric acid.

Cancer of the Tongue.—*Causes.*—Local irritation. Following psoriasis or leuco-plakia of the tongue.

Symptoms.—The disease is nearly always epithelioma, and occurs in adult life, attacking most frequently the male sex after the age of forty. It commences as a tubercle or fissure on the tip or side of the tongue, or as a shallow, slow-growing ulcer subsequent to leuco-plakia. When it begins as a tubercle this is flat and hard, of a reddish purple colour, and soon breaks down into an ulcer; if a fissure be the primary form it has a hard brawny base, unhealthy surface, and callous edges. However produced, the result may either be a warty, somewhat fungating growth, with a broad base, implicating deeply the substance of the tongue; or a rugged,

irregular, and deep ulcer, with raised indurated and everted edges, and usually situated more on one side of the tongue than the other. The parts around are hard and firm, and the whole organ may be brawny. As the disease progresses it attacks the floor of the mouth and adjacent parts. Secondly the glands of the neck are involved, forming a tumour, at first circumscribed, but afterwards diffuse, and covered by purplish thin integument, which finally gives way, producing an ulcerated surface. There are great fœtor of the breath, profuse salivation, and very severe neuralgic pain increased by speaking, mastication, or swallowing, and radiating over the ear, occiput, or temporal regions. Cachexia finally supervenes, and death results from starvation, exhaustion, gastric and pulmonary disease, blood poisoning, or from the occurrence of hæmorrhage from the progressive ulceration opening the lingual artery or some of its branches.

Diagnosis.—The disease with which it is most likely to be mistaken is syphilis. Agnew gives the following table, which shows the difference at a glance:—

EPITHELIOMATOUS ULCERATION.	SYPHILITIC ULCERATION.
1. Commences near the side and generally behind the middle of the tongue.	1. May occur at any part of the organ, generally at the dorsum.
2. Pain sharp, lancinating.	2. Little if any pain.
3. Movements of the tongue restricted.	3. Movements unembarrassed.
4. Articulation imperfect.	4. Articulation perfect.
5. Progress rapid.	5. Progress slow.
6. Appears at or after middle life.	6. Appears before middle life as a rule.
7. Induration precedes ulceration.	7. Induration succeeds ulceration.
8. Fœtor of discharges very offensive.	8. Fœtor not necessarily present.
9. Not influenced by treatment.	9. Improves under treatment.
10. Not necessarily any sign of syphilis.	10. Always traceable to a syphilitic origin.
11. Involvement of the lymph glands common.	11. Involvement of the lymph glands not common.

The syphilitic ulcer is accompanied by other symptoms of syphilis, is elongated, irregular, and does not rapidly extend; whilst the cancerous ulcer is more circular, with hard, ragged edges, spreads rapidly, and is very tender. The syphilitic tubercle is distinguished from cancerous tubercle by its duration, the presence of other symptoms of syphilis, and its deep situation in the substance

of the tongue. Cancerous tubercle occupies the tip or edges.

The microscopical examination of the scrapings of the ulcer is sometimes of service. In cancerous ulcers Butlin describes the appearances of the scrapings thus: "Numerous epithelial cells, in addition to pus and blood corpuscles, débris of food, and schizomycetes. But the epithelium differs widely from the healthy

epithelium of the tongue. The cells vary much in shape and size, and often present singularly distorted forms; their nuclei are always much larger than those of normal cells, and sometimes there are several nuclei, or even nucleated cells within the larger cells; while a greater or less quantity of granular material always occupies the interior of the cells. Not infrequently cell-nests or fragments of cell-nests may be observed."

Treatment.—The only means of a radical cure is extirpation, provided complete removal of the disease be possible, but this often cannot be effected owing to the diffusion of the cancerous infiltration. To remove fœtor, powdered iodoform is the best antiseptic. (Butlin recommends borax gr. iij—iv, iodoform gr. j, morphia gr. $\frac{1}{8}$ to $\frac{1}{2}$). For the relief of pain, etc. (*vide* Cancer of the Breast).

Section of the Gustatory Nerve is performed to alleviate the severe pain and check salivation.

(a) *Hilton's Method.*—The tongue should be drawn aside by an assistant, and the mucous membrane divided for an inch parallel to the alveolar border, beginning at the last molar tooth. The nerve is then found in the submucous tissue, raised by a blunt hook, seen, and divided.

(b) *Moore's Method.*—The nerve is cut about half an inch from the last molar tooth, at a point where it crosses a line drawn from this tooth to the angle of the jaw. A curved bistoury is entered three-quarters of an inch behind and below the last molar tooth, pressed down to the bone, and an incision made towards the tooth. The relief is instantaneous, the pain ceasing, and the salivation diminishing.

Ligature of the Lingual Artery has been practised in order to check hæmorrhage from the cancerous ulcer, and also in the hope of starving the growth.

Operation.—The best seat to apply a ligature is in the triangle bounded posteriorly by the hinder belly of the digastric, anteriorly by the posterior border of the mylo-hyoid, and above by the hypoglossal nerve. The vessel is covered here by the skin, platysma, cervical fascia, submaxillary gland, and the hyoglossus muscle. The three important guides are the digastric tendon, and the great horn of the hyoid bone below the artery; and the hypoglossal nerve immediately above the vessel, but separated by the hyoglossus

muscle.—(1st Step.) The head is drawn over to the opposite side. A curved incision is made two inches long, with its concavity upwards and having its centre a quarter-inch above the hyoid bone, at a point midway between the median line and the tip of the great cornu.—(2nd Step.) Divide the skin, platysma, and cervical fascia, and draw the posterior facial vein outwards.—(3rd Step.) Raise the submaxillary gland and look for the posterior belly of the digastric, passing downwards and forwards to its attachments to the hyoid bone; the posterior border of the mylo-hyoid; and the hypoglossal nerve behind and below the digastric, accompanied by the lingual vein, lying in front of the hyoglossus.—(4th Step.) Draw the hyoid bone slightly downwards, with a blunt hook fixed in the lower angle of the triangle, and then divide the fibres of the hyoglossus along a line parallel with the nerve and midway between it and the bone. The artery will then be seen and ligatured; if more room be required, divide the posterior border of the mylo-hyoid muscle.

Bryant prefers a horizontal incision on a level with the hyoid bone, its centre corresponding to the end of the great cornu.

Agnew recommends an incision beginning at the anterior border of the sterno-mastoid, half an inch above a point opposite the extremity of the great horn of the hyoid, and carries it forwards and a little downwards, so as to give it a slight curve with the convexity below, terminating the cut three-quarters of an inch short of the median line and half an inch below the base of the jaw.

Operations for the Removal of the Tongue.—In all operations about the mouth chloroform should be used as the anæsthetic, and not ether.

1. *Oral Methods.* (a) *Sir James Paget's.*—A gag being applied, the tongue should be seized by claw forceps and drawn out of the mouth, or a ligature may be passed through the tip and used for the same purpose; the mucous membrane and the soft parts of the floor of the mouth are divided, with strong blunt-pointed scissors, close to the bone, including the attachments of the genio-hyo-glossus to the symphysis. Strong curved pins are passed from under the tongue on each side of the frænum, emerging on the upper surface. The wire cord of an

écraseur is then passed round the root of the tongue behind the pins, as low down as possible, and slowly tightened. The hæmorrhage is slight.

(b) *Morrant Baker's*.—After the introduction of a suitable gag, and the removal of any sharp or jagged teeth which might be in the way of the operator, two threads are passed through the tongue, about an inch behind the tip and half an inch on each side of the middle line. The tongue being drawn forwards and upwards, the attachments are divided as in the preceding operation. The operator now with his forefinger clears the tongue in front and at the sides, and drawing it well forward again, giving one thread to an assistant and holding the other himself, he cuts steadily along the middle line of the tongue from before backwards, and farthest along the mucous membrane. On the withdrawal of the knife the finger is now again introduced, and it will be found quite easy to complete with it the median division of the tongue by a little tearing or splitting between the two halves. The only part which cannot be thus torn is the mucous membrane of the dorsum. Hence the advice just given, to divide this with the knife as far as may seem necessary for getting beyond the level of the disease. The écraseur is now slipped over the diseased half of the tongue, this being one of the most important parts of the operation. The insertion of one or two curved needles well behind the disease, before the application of the écraseur, in order to insure the division of healthy tissue, is advisable, but must not be considered a sufficient safeguard in the absence of free separation of the tongue's attachments in front and at the sides. When one half of the tongue has been removed the process is repeated on the other side. If only one half have to be removed the median section is made before the attachments in front and on the diseased side are divided, the healthy side being left intact. The écraseur employed should be curved on the flat, and strong whipcord will be found more serviceable than the linked chain; if necessary, the cheek may be divided, as recommended by Gant. It is often advisable, especially when the disease has advanced into the mucous membrane of the floor of the mouth, to extract three or four of the

neighbouring teeth from the lower jaw, and when the disease approaches or invades the gum much valuable space may be gained by cutting away a portion of the alveolar border.

(c) *Whitehead's Method*.—1. Mouth is widely opened with a gag, which is in charge of an assistant. 2. Tongue is drawn out of the mouth by a double ligature passed through its substance, one inch from the tip. A second assistant keeps up *steady, constant* traction on the ligature downwards and outwards. 3. All attachments of the tongue to the jaw and pillars of the fauces are divided by means of scissors. 4. By a series of short snips with the scissors, all the muscles attached to the base of the tongue are divided until the entire tongue is separated on the plane of the inferior border of the lower jaw, and as far back as the safety of the epiglottis will permit. 5. Lingual and other arteries are twisted *as they are divided*. 6. A single loop of silk is passed by a long needle through the remains of the glosso-epiglottidean fold of mucous membrane, as a means of drawing forward the floor of the mouth should secondary hæmorrhage take place. This method is very good, as the bleeding is very slight, provided there be a good assistant to pick up and twist the arteries as divided, a good light, and a clear view can be obtained by the mouth being able to be widely opened.

2. *Infra-Maxillary Operations*. (a) *Nunnely's Method*.—A small incision is made beneath the jaw through the skin, mylo-hyoid, and genio-hyoid muscles, and through this a curved needle is passed bearing the wire cord of the écraseur completely round the base of the organ. Two or three curved and strong hare-lip pins are passed deeply into the tongue, obliquely behind the seat of the disease, their points being made to project forwards below the organ, to prevent the wire slipping. The loop is gradually tightened, and the tongue shaved off obliquely from behind forwards. Barwell has modified this operation. He makes a small supra-hyoid wound, and carries a thread into the mouth by means of a handled needle much farther back than in Nunnely's operation. The needle enters the mouth close to the last molar tooth on each side, and, by means of a thread, the wire of the écraseur is drawn

through the wound round the base of the tongue. A handled needle is passed through the tongue at the place of section, and the wire slipped behind it. The tongue is divided, and a second *écraseur* used to divide the sublingual tissues.

(b) *Submental (Regnoli's Method)*.—An incision is made, of a semilunar shape, through the skin, along the lower border of the inferior maxilla, commencing at one angle and extending to the other, but stopping short of the facial arteries. A perpendicular incision is carried from this, extending in the median line to the hyoid bone. The triangular flaps are dissected back, and the muscles divided at their attachments to the lower jaw (mylo-hyoid, anterior belly of the digastric, genio-hyoid, and genio-hyo-glossus), the mucous membrane separated by the fingers, and divided to an extent corresponding with the external wound. The tongue is then drawn forwards through the opening thus made, and removed close to the hyoid by the knife, scissors, or *écraseur*. This operation is now seldom performed.

(c) *Kocher's Operation*.—1. Perform tracheotomy. 2. Stuff the pharynx with a sponge fastened to string and steeped in carbolic solution. 3. Make an incision (under aseptic precautions), commencing a little below the tip of the ear, running along the anterior border of the sterno-mastoid, to the upper border of the hyoid, then forwards to the body of the hyoid, and finally upwards along the anterior belly of the digastric. 4. Ligate the lingual artery. 5. If thought necessary, ligature the other. 6. Commencing behind, remove the glands and all structures at the posterior inferior aspect of the tongue. 7. Remove the tongue. 8. Apply the usual aseptic dressing, or a sponge wrung out of carbolic solution. The wound is left to granulate, and no sutures are used. The tracheotomy tube is not removed until the external wound be healed, as recommended by Barker and Kocher. This operation is the best when the disease is extensive.

3. *By Division of the Lower Jaw*.—*Sédillot's or Syme's Method*.—Instruments required: 1. Scalpel; 2. Torsion and artery forceps; 3. Gag; 4. Bone drill; 5. Cheek retractors; 6. Incisor tooth forceps; 7. Narrow saw; 8. *Nævus*

needle and half a yard of thick whipcord; 9. Stout copper wire; 10. Wire twister; 11. Wire nippers; 12. Stout acupuncture needle; 13. Hare-lip pins; 14. Two *écraseurs*; 15. Needle for passing chain; 16. Sharp and blunt hooks; 17. Stout silk; 18. Metallic sutures; 19. Ligatures; 20. Ice; 21. Perchloride of iron; 22. Cautery iron; 23. Solution of chloride of zinc; 24. Collodion; 25. Small sponges mounted on sticks; 26. Brandy, ammonia, and ether; 27. Chloroform and inhaler; 28. Lint and absorbent cotton; 29. Mackintosh sheet.

Operation.—One of the median incisor teeth is drawn from the lower jaw, and an incision made in the median line from the free border of the lower lip to the hyoid bone. The parts are dissected back a quarter of an inch on each side, and a hole is drilled in the bone on either side of the middle line, to be afterwards used in securing the two halves with wire. The jaw is sawn through in the line of the incision, or may be partly sawn through, and then divided by bone forceps. The division may be effected by two oblique lines forming a <, the apex being directed to one side. The attachments of the genio-hyo-glossus are next divided, and the mucous membrane along the ramus of the jaw. The halves of the jaw are forcibly separated, and the tongue being drawn forwards and to one side by a ligature passed through its tip, the attachments to the hyoid bone are divided, in effecting which the lingual artery is cut, and must be at once secured. If there be any difficulty in seizing the artery, a manœuvre recommended by Christopher Heath is of great service. The finger is passed well down to the epiglottis and hyoid bone, hooked well forwards towards the symphysis menti, stretching the lingual arteries so as to completely control the flow of blood through them. The tissues on the other side are then divided, the other lingual secured, and the remaining attachments being severed, the tongue is removed. The divided maxilla is joined by metallic wire passed through the drill holes. The wound in the lower lip is united by hare-lip pins, the lower angle being left open for drainage.

Partial Removal is performed by means of the knife, ligature, or *écraseur*.

1. By the knife.—If the apex be affected, a V-shaped incision is used; if

the lateral region, a bold, free incision with a probe-pointed bistoury. The diseased part is seized with a vulsellum forceps, the tongue well drawn forwards, a clamp with curved blades applied to control the vessels, and the part rapidly excised. Hæmorrhage is stopped by ligature, torsion, or the actual cautery, and the clamp removed.

2. By ligature.—This is now seldom used. The ligature is passed by means of a nævus needle, through healthy tissue wide of the disease, and the threads tied tightly. The included mass sloughs away in a few days, leaving a granulating surface.

3. The *écraseur*, or *galvano-écraseur*, can be used to remove a portion of the tongue in the same manner as for the removal of the entire organ. Two *écraseurs* are commonly required. In using the wire *écraseur* the loop can be passed very quickly, by introducing through the tongue a curved trocar and canula, and on withdrawing the former, carrying the wire through the canula, which can be afterwards removed.

Dangers of Operations for Removal of the Tongue.—1. Hæmorrhage and entrance of blood into the air passages. 2. Pyæmia or septicæmia. 3. Pulmonary affections.

After-treatment.—Powdered iodoform should be sprinkled over the stump once or twice a day. Ice is to be freely used for some days. All saliva, etc., should be expectorated. The patient must be fed by an œsophageal tube, or nutrient enemata and suppositories for the first few days. If secondary hæmorrhage occur, ice or ice-cold water, or pressure by a sponge on a stick; or if the vessel be large, it should be ligatured, the stump of the tongue being drawn forwards with forceps. After removal of the tongue the power of swallowing and, to some extent, that of speaking remains.

Ranula is a cyst situated under the tongue, and projecting into the floor of the mouth near the frænum.

Symptoms.—It forms a soft fluctuating tumour, of a spherical form, and a greyish or bluish colour. It is semi-transparent, and contains a clear, yellowish, glutinous fluid. It may attain a considerable size if not treated, completely occupying the cavity of the

mouth and projecting under the jaw. The tongue is impeded in its movements, and deglutition and speech interfered with. The tumour may appear in either sex, and at any age, but most commonly from eighteen to thirty. It produces little pain or disturbance of the general health.

Pathology.—The swelling is usually a retention cyst, from occlusion of one of three glands opening into the mouth, namely the sublingual, submaxillary, and glands of Riviniani. Cysts containing sebaceous matter are also met with, being often congenital. There are cases of cyst-like swelling under the tongue, which occur suddenly (*subglossitis*). These are due to œdema, and disappear with the inflammation which produces them. I have noticed several times their connection with alveolar abscess of the lower jaw.

Treatment.—If a calculus be present it should be removed. For the radical cure of a ranula four plans may be adopted. 1. Complete excision, which is more easily performed than might be supposed, owing to the loose connexions of the cyst with the surrounding structures. A longitudinal incision is made over the tumour, the flaps of mucous membrane reflected to each side, and the cyst removed by traction, the handle of the scalpel, and small curved scissors. 2. Removal of an oval piece of the anterior wall by curved scissors and toothed forceps, the cavity being then filled with lint soaked in iodine: if the disease be very obstinate the parts should be touched with nitrate of silver or nitric acid. 3. Passing a seton through the cyst. 4. Injections into the cyst. A solution of chloride of zinc (45 grs. to 3j) is recommended by Panas; other surgeons use iodine or ergotin, etc.

Diseases of the Uvula and Tonsils.

Elongation of the Uvula is sometimes troublesome, producing irritation of the throat and cough.

Treatment.—Seize the uvula with a pair of polypus forceps and snip it off, a quarter of an inch from its root, with a pair of scissors. This operation is followed by acute catarrh, which lasts a day or two. There may be some bleeding, but this is easily controlled by styptics.

Acute Tonsillitis.—*Causes.*—Exposure to cold and wet, bad drainage, overwork,

etc. It is most common from five to twenty-five, but is met with at all periods in life; it may be epidemic, and in many cases spreads by infection.

Symptoms.—The tonsils become inflamed and red, and are enlarged, extending beyond the anterior pillars of the fauces. There are associated pain and swelling in the region of the neck, increased during deglutition; the lymphatic glands at the base of the jaw are swollen and tender. Tinnitus or partial deafness, spasmodic closure of the jaws, difficulty in breathing, snoring during sleep, and a thick and nasal voice, are often present. The tongue is coated with mucus, and the patient endeavours to clear his throat of a similar substance. There is considerable fever with rigors, headache, chilliness, and pains in the back. The attack commences very suddenly, and occasionally ushers in the invasion of rheumatic fever. It is well to examine the throat in all children suffering from pyrexia, as this is one of the most common causes. The disease frequently affects one tonsil more than another, and when it has once occurred is very apt to return on slight exposure. If suppuration occur the abscess generally points inwards and forwards, and there may be more than one.

Treatment.—An emetic of mustard will often ward off an attack. Leeches under the angle of the jaw in strong adults. Ice to neck is very grateful to the patient, but in some cases steam inhalations, and poultices or fomentations externally, are preferable. A blister to the nape of the neck does good. I have found most benefit attend the internal administration of tr. aconite in drop doses every quarter of an hour, in the following prescription:

R Tr. aconiti ℥vii j,
Vin. antim. ℥ xxx,
Liq. ammon. acet. ʒij,
Aq. ad ʒvj. Misce.

Sig.—One teaspoonful every quarter of an hour.

Other remedies which are sometimes of service are: Mist. guaiaci with sp. ammon. arom.; salicylic acid in rheumatic cases; small and frequent doses of belladonna, as recommended by Heath; and oil of turpentine in mucilage. Hot-water bottles to the feet are useful in the early stage, and hot foot baths. A calomel purge should always be given. As a

stimulant, nothing acts better than a glass of port wine every four hours. Later on, when the feverish symptoms have subsided, liq. ferri perchlor. in ℥xx doses is advantageous.—Locally. Throat sprays or gargles of glycerine of tannin, or liq. ferr. perchlor. To relieve the difficulty in swallowing, a solution of cocaine is of great service. In very severe cases scarification of the tonsils with a probe-pointed bistoury, and the application of nitrate of silver, or tincture of iodine diluted with an equal bulk of alcohol, are necessary. If suppuration occur the abscess must be opened by introducing the knife, guarded with lint or strapping to within half an inch of its point, a little nearer the middle line than the wisdom tooth, and pushed directly backwards, with its cutting edge upwards and inwards, thus avoiding all danger of wounding the internal carotid artery. Heath recommends that in cases where the soft palate covers the tonsil, the knife should be boldly pushed through the former where it is made prominent by the tonsil.

Chronic Enlargement of the Tonsil generally results from one or more attacks of inflammation, and is common in feeble strumous children, in young women in poor health, and in persons who live in a damp locality. It seldom appears after the thirtieth year, and is never seen in old persons; both sexes are equally affected. In most cases it depends upon an increase in the lymphatic element of the tonsil; and is occasionally due to adenoid growths. Usually both tonsils are enlarged, but one is generally more so than the other. The extent of the enlargement varies, but in bad cases the tonsils may touch each other. The colour and consistence of the affected organs vary; in young persons and in recent cases the surface is red, and the glands soft to the touch; in old-standing cases the tonsils are of a pale flesh colour, tough and firm in consistence, and rough and nodulated on the surface. The follicles are increased in size, and contain plugs of cheesy matter, lymph, mucus, or calcareous concretions.

Symptoms.—Uneasiness in the throat, thick and husky voice; noisy respiration, performed with the mouth open; during sleep the breathing is snoring and

stertorous. Deafness, from obstruction of the Eustachian tube, is not uncommon. There is a great liability to attacks of inflammation, associated with coryza and bronchial complications. In consequence of the obstruction produced in a child, the aspect changes, the nostrils are dilated, the mouth is kept open, the countenance has a dull, vacant expression, and the chest becomes arched behind, contracted at the sides, and flattened in front.

Treatment. — Constitutional. Iron, iodide of iron, sulphate of potash, acetate of zinc, cod-liver oil, and pancreatic emulsion are the most useful drugs. Good food, pure air, suitable exercise, and a healthy, dry residence. Sea bathing, under proper precautions, is sometimes of service.—Locally. In slight cases the application of nitrate of silver, iodide of zinc, perchloride of iron and glycerine, or solution of chloride of zinc. Injections into the tonsil by a hypodermic syringe, of a solution composed of iodine gr. ij, pot. iod. gr. xl, aqua ʒj, repeated twice a week for two months. In more severe cases cauterisation with a mixture of equal parts of caustic soda and unslaked lime mixed in a porcelain dish, with a little absolute alcohol, just before being used. This paste is applied with a glass rod and repeated in three days. Electrolysis by means of a battery of forty cells: a long platinum needle connected with the negative pole is inserted into the tonsil, and a sponge electrode attached to the positive pole is applied over the neck below the angle of the jaw. When these measures are ineffectual the tonsils, or rather the redundant portions of them, must be excised. This operation is, as a rule, painless, but in children or nervous patients an anæsthetic should be administered and the mouth kept open by Smith's gag. Excision may be performed by the tonsil guillotine, but it is preferable to seize the tonsil with a vulsellum forceps, put it on the stretch, and cut away upwards and inwards with a probe-pointed bistoury—the posterior part of which is guarded by a piece of strapping—as much as may be necessary (it is never requisite to remove more than half the tonsil). The hæmorrhage is, as a rule, slight, but in some cases profuse, violent, and almost uncontrollable. In certain cases the presence

of chalky concretions or dense connective tissue prevents the vessels contracting, and so predisposes to bleeding. In such a case the surgeon may first try direct pressure by his finger introduced into the mouth and applied directly to the wound, counter-pressure being made from the front and maintained for several minutes. If this do not check it, styptics are to be used, as ice, hot water, gallic acid, perchloride of iron. A piece of lint mounted on a stick and soaked in perchloride of iron is of great service. Erichsen mentions a case in which gargles of oil of turpentine in mucilage were successful. A useful preparation is—

R Tannic acid gr. 360,
Gallic acid gr. 120,
Aqua ʒj,

held in the mouth or slowly sipped. Seizing the part and compressing it with strong, deeply-serrated forceps. The actual cautery, applied by means of a hot knitting-needle. After removal of the tonsils the patient should stop in a warm room for a few days.

Post-Pharyngeal or Retro-Pharyngeal Abscess is an abscess in the connective tissue between the pharynx and the spine.

Causes.—It occurs in connexion with disease of the bones at the base of the skull and of the cervical vertebræ. In children it is often idiopathic, being due to inflammation of the post-pharyngeal lymph glands with the surrounding connective tissue, but, at the same time, tubercle or inherited syphilis may be associated. Other causes are: Suppressed perspiration; extension of inflammation from adjacent parts, as the palate, pharynx, or tonsil; erysipelas of the neck and face; stricture of the œsophagus; irritation of decayed teeth; after the exanthems as measles, scarlatina, typhoid, and small-pox. Traumatic causes, as fracture of the spine; impaction of a foreign body, as pins, needles, pieces of bone, etc.; scalding liquids; irritants. Retro-pharyngeal abscess may arise from disease of the nose, some of the lymphatics of which terminate in two small lymphatic glands in the front of the spine.

Symptoms.—The pus forms between the spine and the posterior wall of the pharynx, which it bulges forwards. When acute, the parts are red and much

inflamed, the pain deep-seated and throbbing, great difficulty in swallowing, and dyspnœa, relieved by the erect position. In children there are often severe convulsions. When the abscess is in the naso-pharynx it closes the posterior nares, causing the voice to be of a nasal character; if lower down, it presses on the larynx, and interferes with respiration. The neck, behind the angle of the jaw on the corresponding side, is indurated and swollen. Rigors and fever are present. In sleep the patient makes a snoring noise. The head is thrown backwards as the disease progresses. The abscess can be detected by the finger passed into the pharynx; it forms an ovoidal elastic swelling, generally unilateral. In some cases the mouth is with difficulty opened, and there is profuse secretion of mucus.

The *chronic* form, which arises from diseased bone, gives rise to similar symptoms, the most characteristic being the difficulty in swallowing and breathing. There is little fever, and the symptoms of inflammation are less marked.

Terminations.—The abscess may resolve, but this is of rare occurrence. It may burst into the mouth, or come forward, under the sterno-mastoid, to the fore part of the neck, or produce suffocation from pressure on the glottis or escape of matter into the air-passages. Now and then it follows the course of the brachial plexus to the axilla. If post-œsophageal, it may open into the gullet, lung, pleura, or a bronchus. Œdema of the glottis, and opening of the internal carotid artery, may occur.

Treatment.—Evacuate the pus by making an incision into the posterior wall of the pharynx with a flat trocar and canula, and enlarge the opening with an abscess knife, a sharp-pointed bistoury properly protected with plaster, or a pharyngotome. In many cases an aspirator can be used, and is to be preferred. When, on account of laryngeal spasm or œdema of the glottis, suffocation is imminent, laryngotomy may be performed.

Congenital Fistulæ of the Neck, or Branchial Fistulæ, are due to arrest of development of the pharyngeal fissure or cleft. The branchial arches in the fœtus should close about the end of the second month of intra-uterine life; if this union be incomplete a branchial

fistula results. In many cases this condition is hereditary, and, although present at birth, may be overlooked.

Situation.—It is usually met with on the right side of the neck, behind or in front of the sterno-mastoid muscle, between the thyroid cartilage and the sterno-clavicular articulation, but it may occur as high as the angle of the jaw; it usually opens into the pharynx, but occasionally into the larynx or trachea. In direction it may be straight or winding, and generally runs towards the great cornu of the hyoid. The passage can be felt as a hard cord.

Symptoms.—The fistula is generally very narrow, only admitting a small probe; the external aperture may be surrounded with granulations or hidden under a fold of skin. The narrow passage is lined with mucous membrane, and discharges a thin viscid fluid, which may be puriform. The exudation is increased during swallowing, or from mental excitement. Food does not escape through the fistula.

Treatment.—As a rule none is required.

Bronchocele, or Goitre, is an enlargement of the thyroid gland, which more especially affects the female sex. There are four varieties: 1. Simple hypertrophy; 2. Cystic; 3. Pulsating; 4. Acute or inflammatory.

1. *Simple Hypertrophy* is due to enlargement of the stroma and proper gland tissue of the thyroid (fibro-adenoma). If the stroma be much increased the term fibroid bronchocele is used. The swelling varies in size from slight fulness to a prominent lobulated growth extending from the chin to the sternum. Sometimes the whole gland is equally affected, but generally one side is larger than the other, and the enlargement may be entirely confined to one lobe. The chief symptoms are due to the effects of pressure on the adjacent structures; the veins over the surface of the swelling, together with those of the neck and face, are much distended; dyspnœa, due to pressure on the trachea, which is more or less flattened and elliptical, and its cartilaginous rings softened. The difficulty in breathing is proportionate to the narrowing of the lumen of the trachea, and may lead to bronchial catarrh, emphysema, or dilatation of the heart.

Pressure on the laryngeal nerves produces paralysis of the vocal cords, and the voice becomes hoarse and croaking. The return of blood from the brain may be hindered, giving rise to headache, giddiness, drowsiness, etc.; in other cases, from pressure on the carotids, more or less cerebral anæmia is occasioned, with convulsive symptoms. Difficulty in swallowing is a rare event. The skin over the bronchocele is unaffected, and little or no pain is experienced. When the enlargement is chiefly due to hyperplasia of the glandular elements the swelling is soft and elastic, and of uniform texture throughout; if formed by increase in the stroma, a number of distinct, movable, hard nodules are felt projecting from the surface. This variety sometimes disappears spontaneously, or may undergo colloid, cystic, fatty, or amyloid degeneration. These growths may assume also a malignant change.

2. *Cystic* consists of cysts developed in the substance of the gland, which is usually hypertrophied. The cysts are generally multiple, but by absorption of their walls a large single cyst may be produced. The cysts may contain solid intra-cystic growths of thyroid glandular tissue. The walls of the cysts may be thin and smooth, thickened from fibroid deposit, or even calcified. In most cases the cysts are due to enlargement of the normal gland vesicles, but in some cases are occasioned by hæmatomata; very rarely, the cause is hydatids. The contents are a watery, yellowish, or oily looking fluid containing albumen; as the result of hæmorrhage from the walls, blood may be mixed with the fluid. Cystic bronchocele is usually globular, or oval; sharply limited; fluctuates; is slow and painless in its growth, and does not affect the skin.

3. *Pulsating* occurs from the vessels in and around the gland being much enlarged. The pulsation is heaving, and simultaneous with the heart's beat. In some cases this condition is associated with anæmia and protrusion of the eyeballs (exophthalmic goitre, or Graves' disease). Other symptoms of this condition are; increased frequency of the heart's action: a loud murmur heard in the veins, with a thrill; and in severe cases great emaciation, with profuse sweating and diarrhoea. The ophthalmic symptoms in addition to protrusion

of the eyeball, are: visible pulsations of the central artery of the retina (De Weeker); visible pulsations of the veins; retraction of the upper lid (Stellwag), and often of the lower lid; loss of consensual downward movement of the upper lid (Von Græfe).

Causes.—It is most common in mountainous or hilly districts, where it is generally endemic. In England, Derbyshire, Nottingham, and the chalky districts are favourite localities; it is met with in the valleys of the Alps, Pyrenees, and Apennines; in North America it is usually observed in Vermont, New Hampshire, Connecticut, New York, Virginia, and Pennsylvania. The disease is very prevalent in India, in the Himalayan valleys. In Switzerland it is often associated with idiocy (cretinism). A damp, humid climate; the use of snow or impure water; violent exertion in climbing steep hills, etc., are alleged to be factors in the production of goitre. The sporadic variety may be hereditary, or result from changes in the vascular system accompanying disorders of menstruation, anæmia, pregnancy, etc. Sedentary and indoor lives. Occasionally it occurs subsequent to a twist or strain of the neck. Exophthalmic goitre is due to affection of the cervical sympathetic nerve.

Diagnosis is made by the situation of the growth, its indolent character, slow progress, and by the fact that it moves upwards and downwards with the larynx in deglutition. It is well to remember that occasionally accessory or aberrant portions of the thyroid gland at a distance from its usual situation may become enlarged.

Treatment.—When small and occurring in anæmic individuals, good food, open air exercise, removal to a dry healthy locality. Internally, iodide of iron, or Lugol's solution:

R Iodinii gr. xx,
Pot. iod. gr. xxx,
Aque ʒj.
M. Sig. ʒi vj—xx. t.d.s.

Externally, iodide of ammonium or iodide of lead ointments. Blisters are sometimes useful. Dr. Moritz Schmidt advises the application of cold by means of Leiter's coils, used daily for several hours, or in severe cases continuously. Woakes counsels the internal use of hydrofluoric acid (ʒi x of half per cent.

solution in an ounce of water twice daily). The air of the room should be kept iodised by means of solid iodine put in a wooden box with a perforated lid, and kept in the room where the patient is by night and day (Bryant).

Mouat's plan of treatment is to rub biniodide of mercury ointment (gr. xvi to 3j) into the skin over the tumour for several days, and expose the patient's neck to the heat of a mid-day sun or bright fire. If the tumour press much on the larynx the sterno-mastoid should be divided, or tracheotomy may be performed if the dyspnœa be urgent, either from direct pressure of the gland or reflex spasm from irritation of the recurrent laryngeal nerve. When cystic, tapping followed by injection of iodine, or better, Sir Morell Mackenzie's plan of injection of a watery solution of perchloride of iron (25 per cent.). He uses a special syringe, and first punctures the cyst and empties it with a trocar passed through its most dependent part, and plugs the canula; a drachm or two of the solution is then injected into the cyst and left there for seventy-two hours, when it is withdrawn through the canula, which has been left for that purpose. Take care not to wound a vessel, and after inserting the canula wait a short time to see if blood stream out, showing injury to a vessel; if not, the injection can be proceeded with. One injection will generally excite sufficient inflammation; if not, it should be repeated in a few days. When reaction has taken place and the discharge is free from blood, the canula, with its plug, must still be kept in the cyst, and poultices of linseed meal kept constantly applied for three or four weeks. Suppuration having occurred, remove the plug, but retain the canula until the discharge abates. The duration of this treatment is from three weeks to four months. Incision of the cyst under aseptic precautions, and stitching its edges to the skin, has been successfully employed. In some cases the cyst can be shelled out from the adjacent parts. Electrolysis has been used with satisfactory results. When the goitre is large, chronic, and resists medicinal treatment, inject every third day into the gland substance from twenty to thirty drops of an alcoholic iodine solution (one part iodine in twelve parts of absolute alcohol). The

place of injection should be varied, avoiding any veins, the trachea, and large vessels. Semon writes: "Neither insert the point of the needle *too timidly*, when the injection will very likely pass into the cellular tissue, suppuration resulting; nor *too violently*, when it may completely perforate the gland, and the injected fluid may be thrown into other important tissues. It is a good plan to let the patient swallow when the needle has been inserted, before the injection is proceeded with, the body of the syringe being held quite loosely in the operator's hand; if the point of the needle be in the gland substance the *foremost* part of the syringe will rise with the rising gland; if it be in front of the gland, no movement will ensue; if it have perforated the gland, the *hindmost* part of the syringe will chiefly rise." Other means which have been adopted are: excision of the isthmus of the thyroid, which is followed by atrophy of the lobes; ligature of the thyroid arteries, in the hope of starving the bronchocele; and excision of the gland. This latter is very dangerous from the vascularity of the growth; if thought advisable the tumour must be separated by the handle of the scalpel without opening the capsule, all vessels, both arteries and veins, ligatured with two ligatures and then divided between the ligatures until the whole vascular circle is secured and the mass removed. Complete removal of both lobes, as Kocher has shown, is liable to be followed by myxœdema, from loss of function of the gland; thus it is not advisable to remove more than one lobe, when the other will subsequently atrophy. In exophthalmic goitre, iron, digitalis, aconite, strychnia, quinine, and belladonna are the most reliable drugs; for the eye symptoms, ice to the forehead, eyes, and temples.

4. *Acute Bronchocele or Acute Thyroiditis* may be idiopathic, traumatic, or metastatic. It consists in a rapid enlargement of the thyroid, due to inflammation, the size reaching that of the fist in a week. There is pain, which may be intermittent, the part is tender, and the veins enlarged. Pressure symptoms occur similar to those in the other forms of bronchocele. Death may occur from asphyxia. It may terminate in resolution or suppuration with the

formation of abscesses, which may open into the trachea or mediastinum, and produce a fatal result.

Treatment.—The application of ice, leeches, local or general venesection. If suppuration occur, medicated poultices: all abscesses should be opened with a trocar and canula, or incision under aseptic precautions. The abscess cavity should be washed out with carbolic acid solution and tincture of iodine injected. If dyspnoea be very urgent, excision of the isthmus may be performed. The usual antiphlogistic remedies are employed.

Stricture of the Œsophagus.—The chief symptom is difficulty in swallowing, or dysphagia. Erichsen gives the following eight conditions which may produce dysphagia independently of any stricture of the canal: 1. Tumours connected with the pharynx, viz., pharyngeal polypus, post-pharyngeal abscess, or tumour; 2. Morbid conditions of the larynx: œdema, ulceration, thickening of the mucous membrane (whenever dysphagia is accompanied by cough or difficulty in breathing examine the larynx); 3. Tumours in the neck outside the œsophagus, enlarged lymphatic glands, various tumours in the neighbourhood, an enlarged thyroid, aneurism of the internal carotid, etc.; 4. Aneurism of the innominate; 5. Aneurism of the aorta; 6. Intrathoracic tumours; 7. Dislocation of the sternal end of the clavicle; 8. Impaction of a foreign body in the gullet. To these may be added: 9. Paralysis of the pharynx, either central, from injury or disease of the nerve inside or outside the skull, or reflex, from thoracic or abdominal disease; 10. Paralysis of the larynx.

The œsophagus is subject to three different kinds of stricture: 1. Spasmodic or hysterical; 2. Simple fibrous; 3. Malignant.

1. *Spasmodic Stricture, or Nervous Dysphagia*, occurs in young persons about the age of puberty, especially females, also in middle-aged persons, about the change of life. It is often associated with slight ulceration or follicular inflammation of the pharynx. It is combined with other symptoms of hysteria.

Symptoms.—There is a feeling of obstruction at some point which may be constant, but pain is absent. On at-

tempting to swallow great difficulty supervenes, and the stoppage is either complete or yields after some effort. There is often a sense of constriction round the chest, as if a cord were tied round it. The dysphagia often appears suddenly, and vanishes equally quickly. In many cases the dysphagia is intermittent, and should the patient forget her ailment, or nobody be looking at her, swallowing may be effected comfortably. A most common symptom is the forcible expulsion from the mouth of a morsel of food after it has passed a certain distance along the œsophagus; in some cases the patient can swallow liquids but not solids. There are usually no signs of wasting, and the patient is otherwise in good health. If a bougie be passed its progress is stopped, but on continuing the pressure the spasm gives way. The upper part of the canal, particularly the pharynx, is the usual situation affected.

2. *Fibrous Stricture* usually occurs from the action of some corrosive fluid destroying the mucous membrane; it may be met with as the result of simple, syphilitic, or tubercular ulceration, or from ulceration as a consequence of the impaction of a foreign body; as a rare event it may be congenital. It manifests itself at all ages and in both sexes, but is most common under thirty. The most usual site of the stricture is opposite the cricoid cartilage. The part of the gullet affected is the mucous membrane and the submucous connective tissue, which are preternaturally hard and resistant, and of a greyish or greyish-blue colour; in severe cases all the coats may be implicated. The stricture may be unilateral, or involve the whole circumference, and occlude the tube over a space of a few lines to several inches. Above the stricture a pouch is formed, which is capable of containing a considerable amount of food; the mucous membrane of this part may be thinned, thickened, or ulcerated.

Symptoms.—The swallowing of large morsels becomes increasingly difficult, and at last only soft pulpy food or liquids will pass into the stomach. The food is either at once vomited, or is retained in the pouch above the stricture, and then discharged in large quantities. Not unfrequently swallowing is entirely stopped by a spasm, or by a portion of food becoming fixed in the tube. A good deal

of glairy mucus mixed with saliva is regurgitated and expectorated, but no blood unless there be ulceration. The patient is at first tormented with hunger, in the later stages the appetite is lost; emaciation rapidly occurs. If ulceration take place, a bad smelling, semi-purulent fluid is expectorated, and the breath is very offensive. On passing a bougie it rides smoothly over the stricture, and no blood follows its withdrawal. Pain when present is often referred to the sternal notch. It must be noted that this stricture frequently passes into the carcinomatous variety.

3. *Malignant Stricture* is equally common in males and females of advanced years. The usual seat is the upper end of the Œsophagus, opposite the cricoid cartilage, next the lower end near the cardiac orifice, and very rarely the middle part at the bifurcation of the trachea. Epithelioma is the usual form, but scirrhus occurs at the cardiac orifice.

Symptoms.—In addition to symptoms of obstruction similar to those which are present in fibrous stricture, there is severe lancinating pain shooting upwards and backwards between the shoulder blades. An ovoid or elongated tumour can often be perceived by external examination of the throat. The glands of the neck, larynx, and neighbouring organs are liable to be secondarily implicated. The bougie is perceived to pass over a rough and lacerated surface, and its withdrawal is followed by blood; the patient coughs up blood and pus, in which cancer cells can be detected. Great wasting and debility are present, with œdema of the feet and legs; the cancerous cachexia is well marked, the countenance being sallow and cadaverous. Ulceration and perforation of the Œsophagus above or below the stricture may ensue, communicating with cavities in the cellular tissue. Ulceration may occur through the skin, forming fistulous openings into the trachea, or suppuration burrowing between the muscles. Food may pass into the air passages through the ulcer, causing inflammation of the lungs, or one of the great vessels may be opened, producing sudden death. The average duration is thirteen months.

Treatment.—In the spasmodic form, the introduction of a full-sized Œsophageal bougie. Faradisation or galvanisation (v to xxx cells), applied with

an Œsophageal electrode. Bromide of potassium and chloral combined with liq. ferr. perchlor. are useful internally. Antihysterical remedies, as assafœtida, aloes, ether, and valerianate of zinc. Proper attention to diet, exercise, etc. In obstinate cases the seat of obstruction should be mopped with a weak solution of nitrate of silver.

In Organic Strictures.—Feed the patient upon a nourishing diet, as milk, raw eggs, beef tea with Hassall's flour of meat, or Brand's liquid extract, and when he is unable to swallow even liquids, he must be fed through a gum elastic catheter passed through the stricture, and nutrient enemata of beef tea, milk, egg, or minced beef with pancreas, as a suppository. An attempt to dilate the stricture by bougies, or the continuous presence of a tube or catheter, is the best palliative measure at our disposal, but of course bougies should not be tried in malignant strictures. An anæsthetic should be used if necessary. Anodynes may be given by hypodermic injection; if the stricture be very irritable, belladonna in full doses is very serviceable. In syphilitic cases large doses of iodide of potassium freely diluted with water. In fibrous strictures of traumatic origin, perchloride of mercury in small doses is useful if the case be caught early. Durham writes: "In all or almost all cases of stricture or obstruction of the Œsophagus, there is a period, before gastrostomy could be deemed advisable, during which a flexible tube can be passed through the mouth with more or less ease into the stomach, or beyond the seat of obstruction. The passage of a tube (it need be no larger in calibre, though it may be larger, than a No. 8 or 10 catheter), *and the retention of it in the Œsophagus*, not only enables the patient to feed himself satisfactorily, but does good rather than harm, as far as the disease is concerned. The same tube may be worn for a week or more and then changed." Charters Symonds recommends that a gum elastic tube, with at the upper end a funnel expansion, should be inserted by means of a conical bougie; the thin part of the tube is passed through the stricture, and the funnel rests on the top of it. The apparatus is maintained *in situ*, and allows of the passage of properly prepared food. A piece of silk fastened to the upper edge of the tube is brought

out of the mouth and fixed by a loop to the ear; by this means the tube is removed when necessary for examination or the introduction of a larger one. In fibrous strictures electrolysis has not yet received all the attention it deserves. In some instances œsophagotomy or gastrostomy must be performed or the patient will succumb to starvation.

Gastrostomy consists in making an opening into the cavity of the stomach through the abdominal wall. When the opening is permanent, as for œsophageal stricture, the term gastrostomy is applied (*γαστήρ*, the stomach; *στόμα*, mouth). Gastrostomy is used for the removal of foreign bodies lodged in the stomach.

Operation.—The patient is placed in the recumbent position, with the head and shoulders thrown forwards, and anæsthetised.—(1st Step: Incision of the abdominal walls.) A linear incision is made, from three to four inches in length, parallel to, but half an inch to an inch below, the inner side of the cartilages of the left false ribs, ending at the level of the base of the cartilage of the ninth rib. The incision should extend about $1\frac{1}{2}$ inches on each side of the *linea semilunaris*.—(2nd Step: Reach and open the peritoneum.) The dissection is carried through the abdominal wall layer by layer, all bleeding vessels being secured, and capillary hæmorrhage controlled by the pressure of a large sponge. The peritoneum is divided upon a director, a little to the left of the *linea semilunaris*, for $1\frac{1}{2}$ inches in extent. Instead of this, Howse recommends that the lips of the wound should be separated towards the inner part, as widely as possible, by retractors; a *vertical* incision is to be made in the sheath of the rectus, a little way from its outer margin. The vertical fibres of the rectus are then seen and separated with the handle of the scalpel, and the posterior part of the sheath exposed. This should then be incised vertically, together with the sub-peritoneal fat and peritoneum. The object of this is to form an artificial sphincter, and thus prevent the escape of gastric fluid.—(3rd Step: Recognise the stomach.) The stomach is recognised just below the left lobe of the liver by its pink red colour, thick coat, smooth surface, and the arrangement of its arteries. If it cannot be seen, the

forefinger of the left hand must be introduced, and the stomach sought for by passing the finger along the border of the liver, and pressing the transverse colon downwards. The organ being detected, it is seized with ring forceps, and drawn up into the abdominal wound.—(4th Step: Suture the stomach.) There are two methods used in suturing the stomach to the external wound. (a) A single row of sutures of carbolised silk radiating from a circle of about one inch in diameter. From five to eight sutures are required, passed first through the peritoneal and muscular coats of the stomach for half an inch, then through the parietal peritoneum, muscular wall, and skin, for half an inch also, but involving a less extent of muscle. (b) This is the better mode: two rows of stitches are used—an outer and an inner. The outer row is inserted first, at $1\frac{1}{2}$ inches from the point at which the stomach is to be opened, and arranged circularly. Each suture traverses the stomach wall for five-eighths of an inch, avoiding the mucous lining, and passes through the whole thickness of the abdominal wall three-quarters of an inch from the margin of the wound. The stitches should be half an inch apart in the stomach wall, and not tied until all are passed. Lead buttons or bougies are placed under the sutures before they are secured. The part of the stomach exposed in the wound is fixed to the lips of the incision by small wire sutures, introduced with the aid of a small curved needle held in a needle-holder, and only penetrating the serous and muscular coats. The spot for puncturing the stomach is *marked* by a long suture.—(5th Step: Open the stomach.) In five or six days, as advised by Howse, the stomach is opened by drawing the ligature marking the spot slightly forwards, and pushing a long, narrow, sharp-pointed knife straight into the stomach. The opening need not be larger than one-eighth of an inch; a catheter is then passed into the stomach, and the ligature removed. The patient can be fed by a Higginson's syringe, with a small tube to pass into the stomach, and a funnel tube for food, consisting of milk, eggs, peptonised meat, etc. If performed for the removal of a foreign body, an opening should be at once made into the stomach sufficiently

large to allow of extraction without injury to the stomach. A blunt hook or polypus forceps can be used to seize the foreign substance, and the stomach wound closed by the continuous, Lembert's, or Jobert's sutures. After the abdominal wound is sutured, absorbent cotton wool and a flannel binder are applied. The patient should be fed by enemata or suppositories for a week.

Professor Loreta counsels, in cases of œsophageal stricture, instrumental dilatation of the œsophagus through a wound in the stomach as preferable to gastrostomy, since the former effects a radical cure. He cuts down on the stomach, draws the greater part out of the wound, and makes a longitudinal incision through its walls between the two curvatures, and having the upper end as near the cardiac orifice as possible. The orifice of the œsophagus is found, a dilator introduced, guided by the finger, and passed through the stricture; the blades are separated (five centimetres), and the instrument run up and down the œsophagus four times. The wound is sewn up, and the stomach returned into the abdomen.

Bronchotomy, or opening the windpipe, includes the operations of laryngotomy and tracheotomy.

Conditions requiring the operation.—A temporary opening is requisite in acute inflammation of the larynx producing œdema of the glottis or œdema of the larynx; impaction of a foreign body in the gullet pressing on the trachea; scalds of the glottis; foreign bodies in the air-passages; wounds of the thyro-hyoid membrane causing œdema glottidis; diphtheria; morbid growths; laceration of the windpipe. A permanent aperture is needed in chronic diseases of the larynx followed by thickening of the lining membrane, necrosis, etc.; in certain diseases causing pressure on, or displacement of, the trachea, as aneurism, goitre, disease of the spine, etc.; in malignant disease of the larynx; polypus of the larynx.

Laryngotomy is only performed on adults when asphyxia is supervening in cases of: 1. Acute laryngitis; 2. Erysipelatous affections of the throat; 3. Scald of the glottis; 4. Laryngeal spasm from pressure on the recurrent nerve, or in tetanus; 5. Foreign body lodged in or above the glottis; 6. Foreign body in

the gullet; 7. Polypoid or warty growths.

Operation.—The patient resting on his back with the shoulders raised, a cutaneous incision is made in the median line corresponding to the crico-thyroid membrane, one inch in length. This divides the skin and cervical fascia, exposing the crico-thyroid membrane. The crico-thyroid artery, if it bleed, is twisted, and the membrane then opened transversely. A tube is inserted curved on the flat.

Tracheotomy is performed in children for: 1. Scalds; 2. Foreign bodies in the air-passages; 3. Foreign bodies fixed in the gullet; 4. Diphtheria. In adults, whenever a permanent opening is required: for foreign bodies, in the air-passages below the glottis; in operations on the palate, pharynx, or removal of the tongue; in certain cases of cut throat; in some cases of suspended animation.

Operation.—Chloroform being administered and the patient recumbent with his shoulders raised, and the neck made as prominent as possible.—(1st Step.) An incision is made exactly in the middle line, from a little above the cricoid cartilage downwards to within half an inch of the top of the sternum. This incision should only involve the integuments.—(2nd Step.) The superficial layer of the cervical fascia is raised, the surgeon seizing each layer with sharp-toothed forceps on either side of the middle line, elevating the fold and dividing it in the middle line with the knife or scissors. A grooved director may be used. The sterno-hyoids and thyroids are separated with the handle of the scalpel, and the isthmus of the thyroid gland laid bare. Any large veins which may present themselves must be carefully drawn aside or divided between two catgut ligatures.—(3rd Step.) The muscles, etc., being drawn aside with retractors, the isthmus of the thyroid is drawn upwards or downwards with a blunt hook, and three or four rings of the trachea exposed below or above it; in children it is always best to draw the isthmus downwards, and expose the trachea above it.—(4th Step.) The trachea is then transfixed with a sharp hook, drawn forward, and opened from below upwards by pushing the knife, guided by the left forefinger, with

its back towards the sternum, through the rings with a quick thrust.—(5th Step.) Each side of the opening is seized with toothed forceps, and the tube, warmed and oiled, must be then inserted and retained by tapes. Pirrie advises that two aneurism needles should be introduced into the wound and be drawn transversely apart by the hands of an assistant; other surgeons use dilators to facilitate the entrance of the tube. Although the veins may bleed freely, on opening the trachea the hæmorrhage will cease spontaneously. If the isthmus of the thyroid be in the way it may be divided between two ligatures. The tube is best made of aluminium, but vulcanised rubber is also useful. Bryant counsels that in children and infants the opening in the trachea should be made as near the cricoid as possible, the latter being divided if more room be required. Hulke gives a practical hint worthy of attention, namely that the veins in front of the trachea are enclosed between two layers of deep fascia attached to the glottis. If this fascia be fixed by the finger-nail on the cricoid, and both layers divided parallel to this cartilage, by seizing the lower lip of fascia with the forceps it can readily be peeled off the front of the trachea with the handle of the scalpel, as low down as necessary, and thus the operation be rendered nearly bloodless.

Instruments required for Tracheotomy.
—1. Scalpel. 2. Dissecting forceps. 3. Blunt hooks. 4. Sharp hook to draw the trachea forwards. 5. Tracheotomy tube and tapes. 6. Two pairs of toothed forceps. 7. Trachea dilator. 8. Two aneurism needles. 9. Torsion and artery forceps. 10. Sponges. 11. Brandy, ether, and ammonia. 12. Forceps to extract a foreign body. 13. Strapping. 14. Ligatures. 15. Silver sutures. 16. Chloroform and inhaler. 17. Syringe to remove mucus, etc.

Durham's Method is useful where great rapidity is required. He advises that the surgeon standing on the right hand of the patient should make a rapid but careful preliminary examination of the parts. He is then to place the forefinger of his left hand on the left side of the trachea, and the thumb on the right, and make uniform steady pressure until he feels the pulsations of both carotid arteries. By now slightly approximat-

ing the finger and thumb the surgeon feels that the trachea is firmly and securely fixed between them, and the finger and thumb must not be moved until the trachea be opened. In the next place, by a succession of careful incisions the surgeon cuts confidently down on the trachea. The finger and thumb placed on either side help him to judge the exact position of the median line from which the knife must never deviate; and their pressure causes the wound to gape, and the trachea to advance. The forefinger of the right hand is passed from time to time into the wound to make sure there is no important vessel in the way. When the trachea is reached it may be either opened at once or seized with a sharp hook and opened as in the previous method. Durham uses a lobster-tailed canula and a pilot trocar.

After-treatment.—The air of the room must be kept warm, and it is advisable to have curtains round the bed, into which steam is conveyed by means of a tube from a bronchitis kettle. The constant attendance of a trained and watchful nurse is necessary to secure the tube being kept pervious and clean. A piece of muslin or a thin section of a sponge moistened with warm water may be placed over the tube. The canula should be removed when natural respiration is restored, which is ascertained by temporarily plugging the orifice of the tube. It should never be left in for more than three months without being replaced by a new one. As antiseptics, glycerine and boracic acid, or iodoform, are useful. Cocaine will lessen any laryngeal irritation.

Morbid Growths of the Larynx.—Benign growths are papilloma, fibroma, myxoma, adenoma, lymphoma, angioma, cystoma, lipoma, and enchondroma.

Symptoms.—Impairment of voice, impediment to respiration, difficulty in swallowing, cough, and pain.

Diagnosis is made out with the laryngoscope.

Treatment.—Removal either through the mouth under laryngoscopic guidance, or by external incision through the larynx.

Intra-laryngeal.—1. Caustics for small soft papillomata: zinc chloride, silver nitrate, chromic acid, nitric acid, Vienna paste, galvanic cautery. Chromic acid and

nitrate of silver are applied with a sponge, porte-caustique, or by an aluminium probe. 2. Abscission by the laryngeal guillotine. 3. Crushing with strong forceps. 4. Evulsion with Mackenzie's laryngeal forceps.

Extra-laryngeal.—1. Section of the thyro-hyoid membrane. 2. Division of the thyroid cartilago (thyrotomy). 3. Section of the crico-thyroid membrane. The latter is sufficient for small growths beneath the vocal cords, or on their edges. Thyrotomy is used for extensive laryngeal growths, a preliminary tracheotomy being generally performed.

Malignant Growths are sarcoma and carcinoma. Sarcoma is treated by removal. If situated on the posterior part of the larynx it may be removed by the mouth; if on the epiglottis, through the thyro-hyoid membrane; if in the larynx, thyrotomy is required. When the growth cannot be removed, laryngectomy is necessary. Carcinoma is much more frequent than sarcoma, epithelioma being most often met with. If confined to the larynx, laryngectomy; when apnœa is threatening, tracheotomy.

Laryngoscopy.—To examine the larynx an instrument called the laryngoscope is used. It consists of a round, slightly concave mirror, termed the "reflector," and a small mirror, fixed at the end of a handle, which is passed into the mouth, and is called the laryngeal mirror. The light used may be sunlight, or artificial light, as electric, lime, gas, candle, etc. The reflector should be $3\frac{1}{2}$ inches in diameter, with a focal light of 14 inches; it works in a ball-and-socket joint, and may be attached to an elastic band passing round the head, or to a spectacle frame. The reflector is perforated in the centre with a small hole for the spectator's eye. The laryngeal mirror is attached at an angle of 120° to a long stem, which fits into a handle; three sizes are generally used, $\frac{1}{2}$, 1, and $1\frac{1}{2}$ inches in diameter.

Mode of Application.—The patient is placed in a chair opposite the observer, with the lamp on one side of, and sufficiently behind, the person under examination to throw his face in the shade. It is important that the lamp, the patient's mouth, and the reflector should be at the same level. Direct the patient to open his mouth, and throw the light from the reflector into his fauces, so

that the centre of the disc corresponds with the base of the uvula. The patient's tongue is protruded and grasped with a soft towel, with the thumb and forefinger of the surgeon's left hand, the forefinger and other fingers resting on the patient's chin. The laryngeal mirror is previously warmed for a few seconds over the lamp to prevent the expired air condensing on it; the proper temperature is reached when the film which forms on the surface disappears, and the surgeon should apply the back of the mirror to his own cheek to see it is not too hot. Whilst the patient is directed to breathe quite naturally, the surgeon, holding the handle of the laryngeal mirror in his right hand like a pen, introduces it in the middle line of the patient's mouth, and quickly passes it into the fauces until its upper border touches the base of the uvula. During this procedure the mirror is to be held horizontally, the reflecting surface looking downwards and the stem of the instrument placed close to the left corner of the patient's mouth. When the mirror has passed beneath the uvula it is turned upwards until its reflecting surface forms an angle of 90° with the horizon; it is then raised until its upper border reaches the base of the uvula, that organ being slightly elevated by its back. The patient is requested to draw a full breath and say "ah." If the electric laryngoscope be used the laryngeal mirror is lighted by a small incandescent lamp attached to it, and is then introduced into the patient's mouth, no reflecting mirror being required.

What can be seen in a normal larynx.—The epiglottis, its free border, and upper surface; the vocal cords, distinguished by their white colour; between these the subglottic cavity and several rings of the trachea. At the sides of the vocal cords the ventricular bands (false vocal cords); between the vocal cords and ventricular bands is the opening of the ventricle. External to the ventricular bands and continuous with them are the two ary-epiglottidean folds of mucous membrane; between these and the wall of the pharynx is a cavity, which often serves as a pocket for the lodgment of foreign bodies. Posteriorly the arytenoid cartilages, cartilages of Wrisberg and Santorini, can be recognised.

By directing the patient to say "ah," "eh," "e," the approximation of the vocal cords during speech can be ascertained. It must be remembered the view of the larynx is inverted in the mirror, or, in other words, reversed antero-posteriorly. If the larynx be very sensitive the patient may suck small pieces of ice shortly before the examina-

tion, or a 10 to 20 per cent. solution of cocaine may be applied with a brush to the palate. The points to be looked at in examining the larynx are: 1. Anæmia; 2. Structural changes, as thickening, swelling, œdema, abscess, ulceration, new growths; 3. Foreign bodies; 4. Functional changes, as paralysis.

CHAPTER XXIX.

INJURIES OF THE CHEST.

Non-penetrating Wounds of the chest wall are those which do not open the pleural cavity, and are managed on general principles.

Contusions of the chest occur from severe blows, kicks, or falls, and may occasion ecchymosis and extravasation in the lung substance, although the pleura remains entire.

Symptoms.—Difficulty in breathing; expectoration of mucus; pain increased by coughing, breathing, sneezing, or on pressure; crepitation heard by the stethoscope, and dulness on percussion at the back of the lung, but there may be no symptoms on auscultation. The symptoms are generally in a few days, or even weeks, relieved by the patient spitting some dark semi-coagulated blood.

Results which may follow.—Pneumonia, gangrene, cerebral congestion, pericarditis, myocarditis, endocarditis, injury to the heart or great vessels. A contusion of the chest which may not cause the slightest bruise of the skin may originate a rapid pleurisy with effusion.

Sub-pectoral Abscess may either follow an injury or arise spontaneously. It is known by œdematous swelling and inflammation of the surrounding cellular tissue, fluctuation being generally well marked. If necessary, puncture by a grooved needle will make the diagnosis clear from a hæmatoma or rapidly growing malignant tumour.

Treatment.—A free incision made under anæsthesia, in the direction of the fibres of the pectoral muscle; when pus is reached, generally at some depth from the surface, the incision is dilated

with the finger, and a plug of lint or a drainage tube inserted for a few days.

Rupture of the Lung, with or without fracture of the rib, is the result of external violence. The symptoms are similar to those of a wounded lung. The physical signs and symptoms generally follow the injury, but may be delayed for a few days.

Wounds of the Lung and Pleura are the result of penetrating wounds, but may also occur without an external wound, by the end of a fractured rib being driven inwards. The pleura may be wounded without the lung being implicated, either by the weapon pushing the lung before it, or the wound occupying the tenth or eleventh costal space below the limit of the lung.

Symptoms.—Collapse, difficulty of breathing, the respiratory act being mainly abdominal (this is a fallacious symptom, as it is frequently absent). Bloody expectoration, and a discharge of frothy, bright red blood from the external wound, particularly during expiration. Collapse of the lung may happen when the wound is direct and of some extent, but does not occur so frequently as was formerly supposed, owing to the force of cohesion keeping the pleural surfaces of the lung and chest wall in apposition.

Complications.—1. *Hæmorrhage*, varying in quantity in accordance with the depth and locality of the wound, but usually copious, and often soon fatal. In cases of laceration of the lung without external wound, hæmorrhage externally is usually absent. By the end of the second day the expectoration of blood generally diminishes. If the external

wound be small and valvular, and especially if an artery in the chest wall be severed, as the intercostal or a branch of the internal mammary, internal hæmorrhage or hæmothorax may occur.

Hæmothorax.—The quantity of blood poured out varies from a few ounces to several quarts, and this may fill up the pleura and compress the lung without any external indication.

Symptoms.—Coldness of the extremities, clammy perspirations, blanched skin, small weak pulse, extreme oppression of breathing, inability to lie on the sound side, and bulging of the intercostal spaces. Lumbar ecchymosis, occurring two or three days after the injury, and extending from the angle of the false ribs towards the quadratus lumborum muscle, may be present, but is not at all constant.

Auscultation Signs.—Increased dulness on percussion, absence of breath-sounds at the posterior part of the lung, and loss of vocal fremitus and resonance. The blood may be absorbed, or be converted into a purulent fluid.

2. *Emphysema*, or infiltration of air into the cellular tissue of the body, and *pneumothorax*, or the accumulation and confinement of air in the cavity of the pleura, may present themselves as complications of a lung wound. For the production of emphysema there must be an opening in the costal pleura to admit the air into the cellular tissue. At every inspiration air is sucked into the pleural sac through the external wound, or escapes from a wound of the lung substance; with expiration the air in the pleural cavity is compressed by the chest walls, and forced into the connective tissue round the edges of the wound, and should this be oblique and small, the air, being unable to escape, diffuses itself in the cellular tissue beneath the costal pleura, and thence in the large connective tissue planes of the trunk and extremities. Hilton describes a rare form due to rupture of the pulmonary tissue alone, air passing into the posterior mediastinal cellular tissues, and finding its way along the course of the nerves and vessels to the neck, and thence to the limbs. Another way this may happen consists in rupture of the apex of the lung and pleural dome, as the result of severe compression.

Symptoms.—A flat, puffy, undefined

swelling, covered by skin of a normal colour. Crackling on pressure, commencing at the seat of the wound, or opposite a broken rib, and extending over the trunk and neck, is an unmistakable sign of the presence of air. On compression with the finger the air changes its situation, but returns on removal of the finger. In severe cases the air travels rapidly over the whole body, distending all the integuments, and producing unsightly deformity.

Traumatic Pneumothorax is due to the presence of air in the pleural cavity, either passing straight from a wounded lung, or gaining admission from the external air by a wound of the chest wall.

Causes.—Wound of the lung from a fractured rib; rupture or penetrating wounds, as stabs or gun-shot wounds; bursting of a pulmonary abscess.

Symptoms.—Great and increasing dyspnœa; small and irregular pulse, livid countenance; inspiration short, expiration laboured; intercostal spaces obliterated.

Physical Signs.—Drum-like or loud tympanitic resonance on percussion over the whole chest, which is the distinguishing mark from hæmothorax. Diminution or absence of the respiratory murmur, but in some cases this may be amphoric. Vocal fremitus is decreased or wanting. In the sound lung the respiration is puerile. On shaking the patient a noise may be heard like the striking of two small coins together (metallic tinkling).

3. *Pneumonia* frequently follows a wound of the lung, and is not attended with much danger unless a foreign body be present.

Symptoms.—These are similar to those of idiopathic pneumonia, namely, crepitation, dulness on percussion, increased vocal fremitus, rusty sputa, tubular breathing, bronchophony, etc. The traumatic pneumonia is insidious in its onset, without rigors, is more localised, and has a great tendency to resolution, but occasionally terminates in abscess. The fever is always very acute.

4. *Pleurisy and Empyema.*—If the pleura be wounded a certain amount of pleurisy is necessary for the effusion of lymph and union of the pleural surfaces; but if from any cause the inflammation exceed what is required for repair, effusion occurs of serum mixed with flakes of lymph and blood. This effusion will

in three or four days half fill the chest, and suppuration may eventually ensue.

Symptoms.—Dulness on percussion, commencing at the lower part of the chest. Absence of the respiratory murmur, vocal fremitus and resonance over the dull area. Bulging of the intercostal spaces, depression of the diaphragm and displacement of the heart or liver. Difficulty in breathing, and hectic fever. Increase in measurement of the affected side of the chest. Egophony at the upper level of the fluid, provided this be moderate in amount. If the patient be shaken a splashing noise may be heard within the chest.

5. *Collapse of the Lung* may occur from pneumothorax, hæmothorax, or pleuritic effusion and empyema.

Prognosis is always grave. If the wound be occasioned by a broken rib, recovery generally takes place. In punctured wounds near the root of the lung the danger from bleeding is very great. Gun-shot wounds are very serious, as the bullet is usually lodged in the thorax. If the patient survive the first week the chances are favourable to his recovery. From the fourth to the eighth day the danger results from pneumonia, pleurisy, and effusion. Emphysema is rarely dangerous. When both lungs are wounded the outlook is most unfavourable.

Treatment.—All foreign bodies within reach must be withdrawn, and some antiseptic dressing applied, the wound being left open. If the wound, however, be clean cut, with little bleeding, and no escape of air, the edges may be brought together with sutures, and an antiseptic dressing applied. When bloody froth escapes from the wound, and this is large and deep, on no account must it be closed, but an antiseptic dressing applied lightly, the patient placed on the injured side, which is limited in its movements by broad strips of strapping passing from the spine to the sternum, but leaving the seat of the lesion uncovered. Ice applied to the chest is useful.

In hæmorrhage the source of bleeding may be determined by pressing against the lower border of the rib with the finger; or a piece of card-board carried sloping into the wound against the lower border of the rib; if blood stream down the outer side of the card, it flows from the intercostal vessels; if along the inner side, from the thoracic cavity. When

the bleeding proceeds from the intercostal arteries, the wound must be enlarged, and the bleeding vessel secured by a ligature, tenaculum, pressure forceps, or torsion; inclusion of the vessel and the rib, and a compress over the rib, with a ligature carried by a needle round all; digital pressure; steel and ivory clips; complete section of the vessel, and compresses. Gross suggests drilling a small aperture through the rib immediately above the artery, and passing a silver wire round its orifice. If the vessel cannot be secured, a piece of rag is introduced into the wound in the form of a bag, and stuffed with small pieces of rag, so as to compress the vessel as the bag is drawn outwards (Desault). Whatever means are employed, care must be taken not to wound the pleura unnecessarily, by keeping close to the inner surface of the rib.

In hæmorrhage from the internal mammary, the vessel must be secured in the wound, bone or cartilage being removed if necessary.

General Measures to Restrain Hæmorrhage.—Absolute rest in the recumbent position, the patient passing his water, etc., without raising himself. The diet must consist of ice and barley water. In young patients, one free bleeding from the arm, and injections of ergotin, followed by antimonials, aconite, and salines. In old people, calomel and opium.

In Hæmothorax.—The wound must be opened on the fifth day, or aspiration performed, to allow the decomposing blood to escape. If the hæmorrhage continue, in spite of the measures mentioned before, the wound must be closed, the patient laid on the injured side, which is firmly strapped; and on the sixth to the eighth day the chest must be tapped, or the wound opened to give an exit to the blood.

Secondary Hæmorrhage, in wounds of the lung, sometimes occurs at a remote period, from defective repair of the parts implicated. Any unusual exertion may occasion it.

In Empyema, paracentesis must be performed early, to avoid collapse of the lung, and the cavity washed out with an antiseptic, as Condy's fluid, etc. Free drainage is necessary, and frequently a counter opening. When a foreign body is out of reach it must

be left, in the hope that it will be discharged, expectorated, or eneysted.

For Emphysema, small incisions or punctures to let the air out of the cellular tissue, together with the pressure of a bandage. If respiration be much oppressed, free venesection will often give relief.

In Pneumothorax, firm strapping, dry cupping, aspiration, or paracentesis.

If a portion of the lung protrude from a chest wound (pneumocoele), if possible it should be gently pressed back whilst the patient draws a deep breath. If left, it will become gangrenous, and can then be removed by the knife or ligature, or allowed to slough off.

Wounds of the Pericardium may occur from blows, stabs, gun-shot wounds, fractured rib or sternum. There may be associated a wound of the heart as well, or some vessel or organ in the mediastina.

Symptoms.—Collapse, followed by symptoms of pericarditis, namely, friction sound, increased precordial dulness of pyramidal shape, great oppression in breathing, small quick pulse. If much blood be effused between the membrane and the heart, the friction sound will be lost.

Prognosis is always serious, though the injury is not necessarily fatal.

Treatment.—The usual medical treatment must be followed. When the pericardium is distended with serum or pus, paracentesis pericardii is necessary.

Tapping the Pericardium is best performed with the aspirator at the left fifth intercostal space, two inches from the sternum, and near the lower rib. The needle should be directed upwards and outwards. If pus be present an incision can be made below the left nipple, and the pericardium drained with aseptic precautions.

Wounds of the Heart and Great Vessels are nearly always fatal; death, however, has in some cases not taken place for days—this depending on the direction and size of the wound—and life may even be prolonged for years. Wounds of the heart present themselves in the following situations in their order of frequency: Right ventricle, left ventricle, apex or base, right auricle, and left auricle. Rupture occurs in different situations: the pericardium is ruptured in half the cases, right ventricle, left

auricle, right auricle, left ventricle. The heart may be wounded by foreign bodies through the œsophagus, or through the air passages, or from the abdominal cavity through the abdomen. In penetrating wounds death may be instantaneous, from internal hæmorrhage into the mediastinum or pleural cavities, or may occur more slowly from blood filling the pericardium and compressing the heart. Foreign bodies have been found encapsuled in the heart a long time after the date of injury.

Symptoms.—Collapse, pain, hæmorrhage, both external and internal, cramps, cold extremities, dyspnœa, etc.

Treatment.—Complete rest, starvation, ice to the part, closure of the external wound, digitalis and belladonna, and early venesection.

Rupture of the Heart or Great Vessels may follow contusions of the chest, or indirect violence, as falls on the head, shoulder, or lower extremities. It is often accompanied with rupture of the valves. Rupture of the heart and pericardium of the severest kind may occur from external violence without there being any mark on the surface of the body.

Treatment is the same as for a wound.

Paracentesis Thoracis, or tapping the chest, is performed to evacuate air, blood, serum, or pus accumulated within the cavity of the pleura. Von Lesser writes: 1. The operation must be performed when the effusion into the pleura imperils vital organs, possibly because of its large quantity, or, what merits equal consideration, by its rapid accumulation, especially if the other lung be not normal. 2. When the great increase of volume on the affected side impedes respiratory motions, and the intercostal spaces are strongly bulged outwards, accompanied by intense dyspnœa, while the patient's face is livid or manifests anxiety. 3. In cases, not only of direct imminent danger to life, but also in the slower cases, where, though the condition of the patient does not appear alarming, he is subject to frequent asthmatic attacks, especially at night, which may produce a sudden strong or great increase of the exudation, and where often death results quite suddenly. 4. Operate in circumscribed purulent exudations, and then according to the views and laws which apply to abscesses. 5. Operate in cases

in which the strength of the patient is so exhausted that spontaneous re-absorption cannot be expected soon or even at all.

Clifford Allbutt states: 1. As a general rule, if an effusion rise above the angle of the scapula, and abide in this quantity or more for two or three weeks in spite of adequate treatment, it must be drawn off whether the patient be embarrassed or not. 2. Withdraw even a pint of fluid if it have lain in the cavity a month. 3. Effusion in both cavities—the amount in both must be considered as one quantity. 4. If the effusion occupy the whole or a great part of the cavity it must be tapped without delay; that is, when the dulness is marked from the base to the clavicle. A fine hypodermic syringe is useful in the detection of fluid.

The best place to perform the operation is the seventh intercostal space, not higher than the sixth nor lower than the eighth on the right side, the ninth on the left. The middle third of the intercostal space is the seat of election, not higher than exactly midway between the two ribs, as the intercostal artery runs near the lower border of the upper rib. "A line drawn horizontally from the nipple round the chest cuts the sixth intercostal space midway between the sternum and the spine. This is a useful rule in tapping the chest" (Holden). Make an incision through the skin with a scalpel, and push the trocar boldly with one thrust through into the pleural sac.

The trocar should tightly fit the canula, and the latter should have a lateral branch to which india-rubber tubing is attached, the end of this passing down beneath the surface of a basin of water. The instrument should always be previously washed in carbolic solution (1 in 20), and be anointed with carbolic oil. When the stream slackens, and becomes jerky, or if cough be produced, or blood appear in the fluid, the canula must be withdrawn and the wound closed with lint and collodion to avoid the admission of air. The aspirator is often serviceable as a substitute for the trocar. In cases where the fluid is purulent the scalpel is used to divide the tissues, layer by layer, and the muscles and pleura, for $1\frac{1}{2}$ inches, then a drainage tube is inserted under strict aseptic precautions. To prevent the tube slipping into the thorax one end is passed through a hole of the same diameter in a piece of caoutchouc, the end is split in four pieces, and the portions turned down and fastened by silver wire to the caoutchouc. A counter opening is often useful, and elevation of the trunk to drain the lower portion of the cavity. Aseptic treatment is of great advantage. The cavity should be washed out with solution of carbolic acid, iodine, or boracic acid. In some cases resection of a rib is necessary, and if contraction of the chest wall or expansion of the lung fail to occur, several ribs may have to be resected to promote a cure.

SECTION VIII.

INJURIES AND DISEASES OF THE ABDOMEN AND PELVIS.

CHAPTER XXX.

INJURIES OF THE ABDOMEN AND PELVIS.

Contusions of the Abdominal Wall occur from blows, falls, squeezes, and kicks. When the injury is simple and unaccompanied by any lesion of the abdominal viscera the case generally does well, but at the same time peritonitis may ensue, even after slight

injuries. The severity depends on the area and depth of the contusion; in some cases there may be no symptoms for some interval after the injury, and then peritonitis may appear. If the muscular fibres be torn across, as occasionally happens, without the in-

tegument being wounded, the muscle atrophies and hernia is apt to follow. In feeble persons the most trifling contusion occasionally gives rise to the formation of intermuscular abscess, which is apt to burrow between the muscular planes, becoming widely diffused, and should therefore be opened early. Such abscesses are prone to occur when much blood has been extravasated. When the whole thickness of the muscular wall is involved death may take place from shock.

Treatment.—Even in the slightest case pursue the treatment as if peritonitis were expected, and no case should be despised. *Rest in bed* for ten days, with warm fomentations to the abdomen. If much blood be effused, cold and evaporating lotions with pressure. Opium or morphia by the mouth, rectum, or subcutaneously.

Contusions associated with Internal Injury to some of the Viscera result from “wind-contusions” in military surgery, from kicks, blows, falls, pressure of a cart wheel, or squeeze between the buffers of a railway carriage. It must always be remembered that there may be severe internal injuries without any breach of the skin or the slightest external mark. The liver, spleen, stomach, and intestine are most frequently met with ruptured. The dangers are, firstly, from “shock,” which always attends these severe injuries, the patient dying in some cases in a state of “collapse” without rallying; secondarily, from internal hæmorrhage; thirdly, from peritonitis.

Symptoms.—The general symptoms which point to internal injury are fixed and radiating pains, persistent or “relapsing shock,” and persistent vomiting. When the *spleen* is injured, severe shock, weakness, coldness and sickness, pallor, small weak pulse, anxiety, pain at the seat of injury, and dulness on percussion in consequence of internal hæmorrhage. When the *liver* is the seat of injury, pain over the situation of that organ, dulness on percussion from internal hæmorrhage, great collapse, followed by peritonitis, jaundice, bilious vomiting, white stools, with occasionally hepatic abscess and diabetes. If the rupture be slight, and especially if it do not involve the peritoneal covering, recovery may ensue. Rupture of the gall

bladder is invariably fatal. When the *kidneys* are affected, constant desire to micturate, urine of a bloody or smoky colour, becoming albuminous; if the kidney be completely disorganised there may be suppression of urine. Retraction of the testicle, pain and tenderness in the lumbar region, with ecchymosis. If slight, the patient may recover. Death, if occurring early, is the result of hæmorrhage; later on it is due to extravasation of urine and abscess. When the *stomach* is involved; very great collapse; severe radiating pains in the region of the stomach, testicle, and lower part of the abdomen; bloody vomiting, though if there be a large rupture no vomiting is present; extreme thirst is often complained of. When the *intestines* are implicated, collapse, severe pains, bloody stools. When the parietal peritoneum is also lacerated there may be emphysema, due to the escape of flatus through the aperture in the gut into the subperitoneal cellular tissue; this commences in the flanks, and extends towards the armpit or the front of the abdomen. It is remarkable that in some cases of ruptured intestine there may be no pain or other symptom for some hours, and the patient may retain the power of locomotion. If the intestine be ruptured, it is generally fatal in from a few hours to four days.

Treatment.—Rest in bed, the patient being kept absolutely in the recumbent position for at least a fortnight. Treat the collapse by hypodermic injections of ether, and hot-water bottles to the feet, etc. Bandage two or three pounds of cotton wool on the abdomen to limit hæmorrhage. If internal bleeding be free and continuous, open the abdomen in the middle line between the ensiform cartilage and umbilicus, clean out the blood clot, etc., and touch the bleeding points with the thermo-cautery; the peritoneum is then to be washed out with clean hot water, dried with sponges, a glass drainage tube inserted, and the wound closed with sutures, dry dressing being applied. If hæmaturia be present, subcutaneous injection of ergotin is useful. If the intestine or stomach be thought to be ruptured, laparotomy must be performed, and the organ treated as if wounded. Morris writes: “In renal injuries, if prolonged and exhausting

suppuration of the kidney occur, the question of nephrectomy should be well considered; and indeed if indications of ruptured kidney or pelvis be marked, and the gravity of the case great, nephrectomy will in the future be probably adopted, as giving the best prospect of recovery." Ice may be sucked in large quantities, but if this be rejected warm water should be given. Pills of opium or hypodermic injections of morphia. *No food, either liquid or solid, for forty-eight hours*; after this time small quantities in a liquid form, as milk. If the intestines be thought to be injured, nutrient enemata or suppositories should be used. Look out for retention of urine, and treat it if present.

Contusions associated with Rupture of Abdominal Vessels.—The vena cava, aorta, coeliac axis, mesenteric, and spermatic vessels, etc., may be ruptured by a forcible blow or crushing violence.

Symptoms.—If the rupture be complete, internal bleeding, collapse, and syncope; if partial, diminution of the calibre of the vessel, gangrene, or aneurism may ensue.

Treatment.—Rest in bed, ice to the abdomen, opium. If bleeding persist or recur, perform laparotomy, search for the vessel and secure it.

Wounds of the Abdomen. 1. *Non-penetrating.*—These are wounds which do not enter the peritoneal cavity, and are to be treated in the usual manner, according to the class of wound to which they belong. If there be bleeding from the epigastric, mammary, circumflex, or lumbar arteries, it will be necessary to deligate both ends of the wounded vessel, enlarging the wound, if requisite, upwards and downwards. If the wound be valvular the blood may burrow widely beneath the skin, or in the connective tissue between the layers of muscles. Poland has pointed out that if the external oblique be wounded parallel to its fibres, and the internal oblique and transversalis be also wounded, there is a liability for the blood and other discharges to collect instead of escaping externally, owing to the closure of the incision in the external oblique. If sutures be required, both a deep and superficial set should be used. Drainage tubes are essential. If there be much gaping of the wound, the shoulders and thighs should be raised on

inclined planes. When the cicatrix is unfavourably situated the patient should wear an elastic belt or truss, to prevent the formation of a ventral hernia at the seat of injury.

2. *Penetrating Wounds without Protrusion of, or Injury to, the Viscera* are more dangerous, owing to the peritoneum being implicated, and the risk of traumatic peritonitis setting in. This class of wound is recognised by the escape of a little bloody serum. Should there be no sign that the wound involve the peritoneum, it is quite inadmissible to introduce a probe, as this might convert a non-penetrating into a penetrating wound. In such a case the wound must be treated as a simple one, the surgeon carefully watching for symptoms of peritonitis. The edges must be brought together with frequent sutures through the whole thickness of the abdominal wall, including the peritoneum, a drainage tube inserted, and the sides supported by pads; the bowels must be emptied with a large enema, barley water and ice given by the mouth, and solid opium gr. ij om. 4 h. or morphia hypodermically. The bladder must be attended to with a catheter. In penetrating wounds complicated with hæmorrhage from wounded vessels, if the bleeding proceed from a wounded artery or vein, either of the parietes, omentum, or mesentery, enlarge the wound, seek for the vessel, and tie both ends with catgut ligatures, or employ torsion: cleanse the peritoneum, and close the external wound. If the vessel cannot be secured at the seat of the wound, the main trunk should be tied between the wound and the heart.

3. *Penetrating Wounds with Protrusion of, or Injury to, the Abdominal Viscera.*—In these the risk of peritonitis is greater, as the contents of the bowels are liable to be poured over the peritoneum, and bleeding to take place into the peritoneal cavity. Wounds of the viscera without protrusion may be known by the escape of gas, fæces, urine, or bile. The best chance for the patient is to perform abdominal section, suture the wounded organ, and wash out the cavity of the abdomen with some antiseptic. Wounds of the intestine are known by griping pains in the abdomen, thirst, nausea, vomiting, bloody stools, tympanites, emphysema. Wounds of the kidney are

distinguished by the same symptoms as in contusion, together with free hæmorrhage, which soon ceases; and after an interval of from a few days to weeks (commonly on the fifth day), by the escape of urine through the wound.

Protrusion of the Intestine, Mesentery, Omentum, or portions of other viscera, through the abdominal wound, is of frequent occurrence, forming a mass which is large in comparison with the size of the aperture; the protruded viscera are often constricted or strangulated by the margins of the opening, and if unreduced will become gangrenous.

Treatment.—If omentum or intestine protrude it should be cleansed with an aseptic sponge and warm water, and then pushed back as quickly as possible, the edges of the wound being held back by retractors, and the abdominal muscles relaxed by bending the thighs and shoulders. If necessary the wound should be enlarged by passing a probe gently, followed by a director, and nicking through the resisting bands with a hernia knife; the opening in the peritoneum need not be enlarged, as it will stretch. In reduction the portion which protruded last must be first returned; in the case of omentum and intestine reduce the latter first, using both hands, one to retain, the other to restore the parts. If the bowel be dirty, clean it with lukewarm water, to which some antiseptic is added, and then return it; should the gut be inflamed or congested, clean and return it, but insert a glass drainage tube. When the bowel is gangrenous it may be left *unreduced*, an incision being made in it; or it may be allowed to slough, with the result that an artificial anus will form; or, thirdly, if the portion of gangrenous gut be high up it is better to perform enterectomy, removing the dead portion with the knife, and joining the edges of healthy bowel securely and accurately with the continuous suture. If omentum be gangrenous, adherent to the wound, bruised, lacerated, or dirty, it should be ligatured in halves with catgut and cut away, the surgeon having first taken the precaution to see no gut is enclosed. If adherent to the wound, it may be left after removing the part beyond the ligature; but when non-adherent, it should be gently pressed back into the abdomen. The wound is closed with

interrupted sutures through the whole thickness of the abdominal wall. In cases of protrusion of solid organs, if recent and unwounded the protrusion should be returned; when wounded or damaged, apply a ligature and remove the protruding part. In the case of the kidney or spleen, the whole organ should be removed. Protrusion of the bladder is rare. I have reported a case in which the bladder and intestines protruded through an extensive wound in the abdominal wall, and were reduced, the woman recovering without a bad symptom. In all cases after reduction introduce a flat sponge over the returned viscera whilst the sutures are put in, then withdraw it before tightening the last stitch. Opium should be given internally, a little milk and water as food, and pancreatised enemata.

Management of Wounded Intestine.—

If the intestine be only minutely punctured, as by an aspirator needle, it may be safely returned. Gross writes: "That the extravasation of faecal matter is greatly influenced by the direction and extent of the wound, I ascertained long ago by numerous experiments performed upon dogs. I found, for example, that when the opening is six lines in extent, whether transverse, oblique, or longitudinal, there is almost invariably an escape of faecal matter, speedily followed by fatal peritonitis. If, however, the wound, whatever may be its direction, does not exceed four lines in length, or a third of an inch, such a contingency will not only be less likely to happen, but in many cases, if not in a majority, nature, aided by appropriate therapeutic measures, will be fully competent to effect restoration. The safety of the patient, in comparatively small wounds of the bowels, no doubt frequently depends upon the diminution which the opening instantly experiences after their infliction, from the contraction of the muscular fibres of the tube, and the eversion of its mucous membrane." When there is a visible puncture, pinch it up with a pair of artery forceps, apply a carbolised catgut ligature round the base, cut the ends off close to the bowel, and return the gut. Should the wound be larger and longitudinal, the circular muscular fibres of the gut contracting will cause the edges to gape, whilst if transverse, from the same reason the

wound will be made smaller. All wounds exceeding one-third of an inch must be closed by suture. Sutures, however introduced, provided the ends are cut short, separate inwards and pass off through the interior of the gut. If the ends be left long, and projecting from the external wound, they ulcerate outwards and escape through the peritoneal cavity. The kind of suture is comparatively unimportant if it secure the severed edges closely and accurately together.

Mode of Union of Wounds of the Intestine.—Travers writes: "It commences with the agglutination of the contiguous mucous surfaces, probably by the exudation of a fluid similar to that which glues together the sides of a recent flesh wound when supported in contact. Then adhesive inflammation supervenes and bends down the reverted edges of the peritoneal coat, from the whole circumference of which a layer of coagulable lymph is effused, so as to envelope the wounded bowel. The action of the longitudinal fibres being opposed by the artificial connexion, the sections mutually recede as the sutures loosen by the process of ulcerative absorption. During this time the lymph deposited becomes organised, by which further retraction is prevented, and the original cylinder with the threads attached to it are encompassed by the new tissue. The gut ulcerates at the points of suture, and these fall into its canal. The fissures left by the sutures are gradually healed up, but the opposed villous surfaces, so far as my observation goes, neither adhere nor become consolidated by the granulation, so that the interstice marking the division internally is probably never obliterated." Travers was thus of opinion that the edges of the mucous membrane never united with each other, but were joined by an intervening layer of organised lymph; other writers are of opinion that the mucous membrane can cicatrise like other tissues, as Gross observes, either by the effusion of absorbed lymph, the edges coming in contact and coalescing in a few weeks to months, or by healing by granulation.

Longitudinal Wounds may be closed by various methods, but three conditions are essential, as laid down by MacCormac. 1. Two adequately broad and sufficiently wide surfaces of peritoneum

must be brought in contact. 2. The mucous membrane must be excluded, for when the needle passes through the whole thickness of the gut, peritonitis generally ensues from leakage taking place along the line of thread. 3. Rapidity of execution is of extreme importance, and that form of suture is best which can be effectively applied in the shortest time.

(a) Jobert's. Simple interrupted suture, the edges being rolled in so as to bring peritoneal coat against peritoneal coat; the ligatures are cut close to the knot. The objection to this method is that the mucous membrane is pierced.

(b) Lembert's method is the best one to employ. A needle carrying the suture, which should be of strong catgut, is entered on the outer surface of the bowel a quarter of an inch from the edge of the wound, and brought out an eighth of an inch from it, without having perforated the mucous membrane. It is entered again on the other side of the wound, at an eighth of an inch from the edge, and brought out at a quarter of an inch. All the ligatures necessary are thus introduced, the intervals between them not exceeding one-sixth of an inch, tied, and cut short; each stitch only includes the peritoneal coat. Hagedorn's intestinal needle and holder are the best for this suture.

Czerney-Lembert suture gives greater security. Two rows of sutures are applied: an inner, consisting of a series of interrupted sutures through the mucous membrane only; an outer, of a series of Lembert's sutures through the peritoneum only. When the latter are tightened the first row is concealed.

(c) Gély's suture is a continuous one. A long ligature is used with a small needle at each end. Each needle enters the bowel about one line, or one-sixth of an inch from the edge, at the upper extremity of the wound; they are then carried down along the interior of the bowel, parallel with the wound, for the sixth of an inch, and brought out on the same side as they entered, so as to appear on the peritoneal surface again. The needles are then crossed and reintroduced on the opposite sides at their respective places of exit, the right needle being passed through the puncture made by the left, and conversely. When as many stitches are made as is

necessary, the loops are tightened and the ends knotted together and cut short.

(d) Travers writes: "I am not aware that any formal directions are required for the operation of sewing up a wound of the intestines. Let a small round sewing needle armed with a silk thread be passed near to the lines formed at the bases of the everted lips. The thread is to be carried at short regular distances through the whole extent of the wound; the operator being mindful that an equal portion of the edges is included in each stitch. When the suture is finished let the thread be securely fastened, and cut close to the knot." Gant writes: "To avoid any tendency to the escape of faecal matter in the intervals of the interrupted suture, the continuous or glover's suture will be preferable for a wound of any extent; observing to pass the thread from within outwards, and from without inwards, alternately, thus to invert the lips of the intestine and bring the peritoneum into contact."

Transverse Wounds.—If the wound only extend half round the intestine, and indeed if the mesenteric attachment be intact, one of the preceding methods of suture should be used. In cases of complete division, Jobert recommends that the lower end of the bowel should be turned in upon itself, and the upper end introduced and fastened with sutures. The surgeon passes a suture, armed with a needle at each end, through the upper extremity of the divided bowel, at two-thirds of an inch from the edge. The lower portion being inverted, the needles are passed through the doubled portion of the gut from within outwards, the outer needle piercing the bowel close to the duplicated border, the inner one about two-thirds of an inch lower down. A similar proceeding is effected on the other side, when by tightening the sutures the upper end enters the lower end of the bowel, being fixed there by knotting the threads. It is advisable to apply a series of Lembert's sutures at the junction of the peritoneal surfaces of the two portions of the gut. If the bowel be extensively damaged, as in gun-shot injuries, the portion irretrievably injured should be removed with the knife, and the healthy edges of cut intestine securely and accurately joined (enterectomy). The mesentery must be removed from the

part of the bowel to be resected as closely to this as possible, and if this portion be large, a triangular piece of mesentery should be excised, all bleeding points being ligatured with catgut. The mucous membrane of the bowel, which is always everted, should be retained. MacCormac writes: "Care must be taken to insert the sutures at the mesenteric border sufficiently deep to ensure complete inversion of the intestine, and to bring the serous surfaces fairly in contact. There is a triangular interval filled with connective tissue and blood-vessels between the layers of the peritoneal coat, as it leaves the bowel to form the mesentery. At this place the needle must be passed deeply enough to include the muscular coat as well as the serous, otherwise extravasation will result." He advises the use of fine silk and a moderately curved needle. A wound of the stomach, if small, should be secured by ligature, if large, by sutures, and the viscus, if protruding, returned into the cavity of the abdomen. If the contents have escaped into the cavity, abdominal section should be at once performed, as it offers the only chance.

After-treatment.—Administer opium. Ice and barley-water for the first three days, then beef-tea, and milk. *No solid food for three weeks.* In wounds of the stomach, nutrient enemata. After a week, an enema may be given, but no purgatives must be administered.

Traumatic Peritonitis, or inflammation of the lining membrane of the abdomen, is often present following injuries of the abdomen, as contusions or wounds. When acute, it is characterised by its sudden onset and rapid course. Acute peritonitis, when diffuse, is generally the result of sapræmia or septicæmia.

Symptoms.—The disease is often ushered in with chilliness or rigors; it commonly commences from six to thirty-six hours after the injury. The patient lies on his back, with his knees drawn up to relax the abdominal muscles. Pain and tenderness over the abdomen, increased by the slightest pressure or movement; the pain is particularly agonising when the inflammation is produced by extravasation of faecal matter, and in septic cases. The abdomen is swollen or tympanitic from paralysis of the muscular fibres of the intestine favouring the formation of

flatus, and preventing its movement. From the same reason constipation is often present, but in septic cases there may be fetid diarrhoea. Respiration is hurried, short, and thoracic. The pulse is small, quick, and hard, feeling like wire under the finger, and beating from 120 to 160 per minute; as the disease progresses it becomes weak, fluttering, and irregular. The tongue is dry, soon becoming brown. The temperature varies; as a rule it is high at the beginning, and continues so for a day or two, but remissions often occur, especially in septic cases, and are very deceptive; the temperature in traumatic peritonitis is not nearly so good a guide as the pulse. In the asthenic form of peritonitis the temperature may even be below the normal. Great thirst is complained of. Vomiting is an important symptom, and, if present, is an unfavourable omen. The urine is high-coloured, loaded with lithates, and retention may be present. The countenance is drawn, anxious, and pinched. There is extreme prostration, but rarely any delirium or weakening of the mental faculties. In the early stages there may be a distinct friction sound, due to the deposit of lymph on the peritoneal surfaces, and audible on auscultation; later on, marked fluctuation, with dulness on percussion in dependent parts, is present from effusion. If suppuration occur the pain is increased. Pollock writes: "Occasionally, but rarely, subsequent to a wound of the abdomen, peritonitis may terminate in the formation of an abscess, confined to a proportionately small space in the peritoneal sac, and that such abscess may of itself open externally, or require the aid of the knife to allow of the exit of matter."

Prognosis.—The gravity of the case increases with the extent of area affected and the rapidity of the symptoms. If the result of direct injury, limited to the parietes of the peritoneum, the prognosis is comparatively favourable, but if due to septicæmia or affection of the viscera, death commonly ensues from collapse in from seven to ten days. Unfavourable signs are cessation of pain, with a sub-normal temperature, cold and clammy surface, pulse so rapid as to be counted with difficulty, voice inaudible, persistent vomiting, and hiccough. Even in favourable cases death may occur at any period

after apparent recovery, from intestinal obstruction, due to adhesive bands, the products of inflammation. In favourable cases the recovery is often very slow, and the pulse will continue quick and irregular long after the other symptoms have disappeared.

Treatment.—Absolute rest in bed. Ice and barley-water to relieve the thirst. Opium and belladonna in the form of suppositories. Leeches in plethoric patients. Warmth, applied by fomentations or Leiter's coil, though in some cases cold gives more relief. Alcohol in the form of brandy or champagne is generally required after the first onset. The diet should consist of beef tea and broths, but all solid food and milk should be interdicted. In suppurative peritonitis, abdominal section, followed by washing out the peritoneal cavity with a weak antiseptic, and then drainage with a glass drainage tube, is the only chance for the patient, desperate as this may seem. In septic peritonitis the bowels should be unloaded with castor oil or sulphate of magnesia. Immense quantities of brandy should be given. The best internal remedy is liq. ferr. perchlor. in m xx doses every two hours. Occasionally *sp. terebinth.* is useful. If there be much vomiting, nutrient enemata of strong pancreatised meat essence are of service. In chronic peritonitis, calomel in small doses, combined with opium, and counter-irritation of the abdomen by strong iodine liniment or blistering fluid, are the most reliable measures.

Fæcal Abscess occurs when intestinal secretion escapes into the peritoneal cavity, or when an adjacent abscess has opened into the bowel.

Symptoms.—Rigor, high temperature, constipation, tympanites. This is followed by more distension, dulness on percussion, redness, œdema, and fluctuation. The abscess may burrow among the abdominal muscles, or open into the vagina, rectum, etc.

Treatment.—Empty the abscess cavity with an aspirator, the discharge being characterised by its extremely offensive odour. The abscess should be washed out with carbolic acid solution. If it refill, open under aseptic precautions, and insert a drainage tube. Iodoform is a good dressing.

Fæcal Fistula. *Causes.*—(a) Ex-

ternal injury: 1. Wound of the abdominal wall and gut, the latter adhering to the former; 2. Sloughing of a portion of contused gut, as after the reduction of a strangulated hernia, etc.; 3. Incomplete union following enterorrhaphy or suture of the gut. (b) Abscess. (c) Any disease causing ulceration and sloughing of the gut. (d) After attempted radical cure of an artificial anus.

Treatment.—Pressure, and rest in bed. Cauterise passage down to the intestine with the galvanic cautery or nitrate of silver, then starve the patient for three or four days, and give enemata. Plug with sponge into which, when dry, iodoform has been rubbed; this must be frequently changed. Should there be a number of fistulous openings, they must be freely divided on a director, except the one most directly connected with the gut. If these measures be not successful, a free incision is made in the abdominal wall, exposing fully the fistulous opening into the bowel which is separated; enterorrhaphy or enterectomy is then practised, according to circumstances.

Injuries to the Pelvis.

Rupture of the Bladder may occur very easily when the organ is distended with urine; from the most trivial injury, as falls on the floor, running against the corner of a table; also in falls backwards, or in lifting heavy weight, or from violence applied to the back. Rupture may be produced in cases of fracture of the pelvis, penetrating wound from without, lastly in rare instances from over-distension of its walls, as in hypertrophy of the prostate, or stricture of the urethra, or as the result of ulceration. In most cases it is the posterior wall which suffers laceration, so that the urine escapes into the peritoneal cavity (intra-peritoneal rupture), producing intense traumatic peritonitis, with a rapidly fatal termination. In those cases where the injury occurs in a part uncovered by peritoneum, as the anterior wall or base of the bladder (extra-peritoneal rupture), the urine finds its way into the connective tissue between the peritoneum and abdominal wall, producing sloughing of the tissues; it may burst into the peritoneum, reach the subcutaneous connective tissue, or pass

through the pelvic foramina into the scrotum and thighs. An open wound of the bladder is not so dangerous as a laceration. The rupture has jagged edges, and is followed by contraction of the bladder, with, in some cases, profuse bleeding.

Symptoms.—Collapse, feeling of something having given way, violent burning pain in the hypogastric region. There is almost constantly an incessant desire to urinate with inability to pass any water, though a small quantity of blood may flow from the urethra. In exceptional cases, however, the power of micturition is not lost. The patient is unable to stand or walk. On passing a catheter the bladder will be found empty, blood or a little bloody urine being alone drawn off, unless the instrument pass through the rent, when urine mixed with blood and peritoneal fluid may be evacuated. These symptoms are soon followed by urgent tenesmus and peritonitis. If the rupture be extra-peritoneal the symptoms are those of extravasation of urine. If death occur it usually happens in three to five days after the injury. The immediate risks are hæmorrhage, shock, peritonitis, and uræmia.

Treatment.—When the laceration is intra-peritoneal, laparotomy should be performed, the peritoneal cavity carefully cleaned of blood and urine; then the rectum should be distended with a rectal bag to bring the parts well into view, and the rupture carefully stitched with silk sutures. Lateral cystotomy is then performed to secure an exit for the urine. If extra-peritoneal, and any extravasation can be made out by external examination, free incisions both supra-pubic and perineal should be made, followed by median or lateral cystotomy. A supporting plan of treatment is required. Opium is always necessary, and the patient should be allowed to suck ice.

Foreign Bodies in the Male Genito-Urinary Organs.—Poulet arranges these thus: (a) Those originating outside the body, and introduced through natural channels. 1. Therapeutic origin.—Catheters, débris of catheters (metallic, india-rubber, guttapercha), bougies, pieces of lithotrite, pieces of nitrate of silver, cup of a caustic-holder, ivory tip of an English sound, carriage pin. 2. Erotic origin.—

Needles, pins, penholders, pencils, pieces of wood, pieces of whalebone, soldier's primers, branch of a vine, canula of a syringe, shoemaker's awl, pipe stem, heads of grains, fruit stones, glass balls, metal balls, pieces of chalk, stem of corn flag, sticks of sealing wax, matches, hair pins, hair rings with seal, fork with four prongs, ear picks, fir branch, cotton wick, iron wire, elaspas, alabaster, cylinder, straw, small key, bougie, glass tube, awl, wax, paper, needle case, pieces of polished leather, head of garlic, fish bones, caudal vertebrae of a squirrel, etc.

3. Various origins (drunkenness, insanity, etc.).—Pebbles, watch chain, copper ring, beans, peas, etc., pins. (β) Introduced through artificial channels.—1. Coming from "effraction:" projectiles, etc., wood, etc., cloth, etc. 2. Coming through a communication: pins, needles, grains of corn, grape seed, fruit stones (plums, peaches), large wads of charpie. (γ) Those formed in the economy: teeth, hair, worms, bone, various débris.

Symptoms.—When the body is in the urethra the symptoms are pain, which may radiate into the perineum, thighs, hypogastrium, and abdomen; incessant desire to micturate; more or less retention, according to the size and shape of the foreign body. Blood mixed with a few drops of urine. If the body be fixed, urethritis results; the penis is red, swollen, and œdematous. Pyrexia.

Terminations.—1. Spontaneous expulsion (rare). 2. Passage into the bladder. 3. Retention in the urethra; in this case the foreign body becomes covered with an incrustation from the deposit of urinary salts.

Sequelæ.—Cystitis, nephritis, orchitis, periurethral abscess, fistulæ. If the urethra be injured extravasation of urine may occur.

Diagnosis is made by the patient's story; examination of the penis, perineum, and per rectum; and exploration with a metallic catheter or sound, the surgeon keeping his finger in the rectum to prevent the substance slipping into the bladder.

Treatment.—If possible extract by the urethral forceps, hooked sound, small lithotrite, wire loops, etc., under an anæsthetic if thought necessary. Occasionally the foreign body may be expelled by ejecting warm oil into the urethra, and then closing the prepuce,

and holding it between the finger and thumb whilst the patient makes a powerful effort to pass water. With regard to pins and hair pins, the points should be pushed through the skin by bending the penis at a right angle, or by pressure from the rectum and a puncture made for extraction; of course a hair-pin must be straightened by separating its branches. If the body cannot be extracted it may either be removed by perineal section, button-hole operation, or pushed into the bladder and extracted by median cystotomy.

Foreign Body in the Bladder occasions symptoms similar to stone. If small, it may be expelled spontaneously, but in most cases it becomes covered with calculous incrustations forming a stone.

Treatment.—If possible, remove it by the lithotrite, through the natural passages. If not able to be thus extracted, median cystotomy must be performed, or if more room be desired, lateral or suprapubic cystotomy.

Wounds of the Generative Organs in the male are occasioned by sharp instruments or bullets, and may be accidental or self-inflicted. I have seen a case of extensive lacerated wound of the penis from the bite of a dog, the corpora cavernosa being nearly completely divided; union occurred readily.

Treatment.—If the skin be alone affected the wound is managed on ordinary principles, but the healing process takes place very rapidly. When the deeper structures are implicated, hæmorrhage is profuse; if distinctly arterial, a ligature or torsion must be applied to the bleeding vessel; should this be impossible, pass an acupuncture needle over or under the dorsal artery, and apply a figure of 8 suture round the ends. If venous or capillary, cold; pressure applied by plaster or a narrow bandage, a large catheter being passed; and astringents.

Rupture of the Frænum may occur from violent sexual intercourse, and the artery being torn, may bleed profusely.

Treatment.—If the rupture of the artery be incomplete, divide it right across with scissors; should the bleeding still continue, the artery may be ligatured or twisted.

Wounds of the Urethra. — Symptoms. Discharge of blood from the meatus of the urethra, and of urine from the

wound. Simple incised wounds, when longitudinal, readily heal.

Treatment.—Pass a catheter and tie it in; bring the edges of the wound together by interrupted sutures. Spence recommends when the superficial wound is small, or the soft parts over the urethra imperfectly divided, dilating the wound freely in the line of the raphe of the perineum, to afford a free outlet for the urine, pus, and sloughs of cellular tissue.

Laceration of the Urethra is met with from blows, kicks, or falls on the perineum, as in bricklayers from falling astride a beam or rope; from the kick of a horse, etc.; or in consequence of indirect violence, as a weight of earth falling on the back of the patient when stooping; rarely it is the result of fractures of the pubic portions of the pelvis. The rupture is usually placed at or immediately in front of the membranous part of the urethra; the solution of continuity may be partial or complete.

Symptoms.—There is as a rule no wound of the integuments. Hæmorrhage, usually in small quantity, oozes from the orifice of the penis, but may stream in a copious flow. There is much pain and general shock. In severe cases there are considerable bruising and extravasation in the perineal region, the skin quickly presenting a dark purple colour. When the neck of the bladder is lacerated as well as the urethra, extravasation of urine occurs immediately; but when the injury is confined to the urethra, on the patient attempting to pass water little or none passes from the meatus, a burning pain is felt in the perineum, the urine passing through the laceration and becoming extravasated. On making an attempt to introduce a catheter, it will be stopped at the point of injury, or pass with difficulty. The most extensive injury to the urethra may be present without any symptom in the perineal region for some time after the accident. A contusion of the perineum without laceration of the urethra is sufficient to occasion retention of urine requiring the use of a catheter. The after-effects are serious, as if the laceration be only partial a traumatic stricture is left; if complete the urethra may be obliterated and perineal fistulæ form.

Treatment. — A full-sized elastic

catheter without a stylet, if possible, but if not, with one, must be passed into the bladder, keeping the point along the roof of the urethra. An india-rubber tube is fastened to the catheter to allow the urine to flow away as fast as it is secreted. If the operator cannot succeed with an elastic instrument, he must cautiously try a silver one. Should this be unsuccessful, the patient must be placed in the lithotomy position, and perineal section by Wheelhouse's or Cook's operations performed. If the rupture be complete, the two ends should be stitched together if possible, through the external wound or perineal section; but should there be much bleeding, this measure must be postponed for a few days. If the perineum be hard and throbbing, free incisions should be made in it. To control bleeding, ice, hot water, and pressure with a petticoated lithotomy tube, or Brown's tampon, are necessary. In cases of retention, where the urethra cannot be found, the bladder may be tapped per rectum. Opium and belladonna suppositories are necessary to relieve the vesical irritability. Good diet and strict cleanliness.

Wounds of the Rectum generally heal well; but if lacerated, and the rectum much separated from its connections, may be followed by erysipelas, hæmorrhage, abscess, sloughing, pyæmia, or peritonitis.

Treatment. — The rectum must be emptied of fecal matter and opium gr. j om. 4 h. administered. The diet should consist of cold scalded milk. The bowels should not be moved for ten or twelve days. If the rectum cannot be kept empty, the sphincter should be divided. For hæmorrhage *vide* Diseases of Rectum.

Foreign Bodies in the Rectum may be divided into: 1. Those introduced through the mouth, which are similar to those met with in œsophagus; 2. Those formed in the intestine, as stercoraceous or calculous masses; 3. Those introduced through the anus, either accidentally, maliciously, or voluntarily (for therapeutic purposes, purposes of concealment, as in thieves, or the gratification of morbid sexual appetite).

Nature of Foreign Bodies.—Pointed or irregular bodies, as fish bones, kernels, needles, pins, nails, egg shells, are generally those introduced by the mouth.

Those passed in through the anus are generally large, and often surprisingly so, as bottles, beer glasses; these are usually smooth, rounded, and blunt.

Symptoms. — 1. Pain. 2. Spasmodic contraction of the muscular coat of the bowel. 3. Constipation; or muco-purulent or bloody stools. 4. Contraction of sphincter. 5. Genito-urinary troubles. 6. When the foreign body is large it may produce a tumour in the perineum. 7. Foreign body can be felt through the anus.

Sequelæ. — Chronic inflammation, ulceration, and gangrene of the mucous lining of the rectum. Profuse hæmorrhages. Invagination of the rectum if the foreign body be hollow. Perirectal cellulitis. If the peritoneum be pierced through the rectum, acute peritonitis. Perforation into the bladder (rare). Abscesses pointing in the abdomen, perineum, labiæ majoræ. Gangrenous abscesses of the ischio-rectal fossa. Abscesses of the margin of the anus. Fistulæ or cracks. Obstruction of the bowels.

Diagnosis is ascertained from the patient's story, subjective symptoms, and bimanual examination through the abdominal wall and rectum. The speculum and bougies are of service. *It is always advisable to examine per anum when constipation has existed for several days.*

Treatment.—Wash out the rectum

with an enema of lukewarm water, and place the patient in a state of anaesthesia. The sphincter should first be forcibly dilated with the two thumbs. Large foreign bodies, if fragile, as glasses, tumblers, stone jars, etc., should be removed if possible intact by the fingers, forceps covered with cloth, dilating forceps, obstetric forceps, hand in the rectum, hooks, etc. If the body cannot be removed whole, the parts must be protected by leather or cotton, and the body broken by a lithotrite, craniotomy forceps, or cephalotribe. If more room be required, linear rectotomy or resection of the coccyx may be used. If the body be not fragile it must be removed with strong forceps or lithotomy extractors. When the body is of wood it may be pierced with a gimlet and thus withdrawn. Pointed bodies that have perforated the walls, if vertical, may be pushed through the skin and thus removed. In other cases the body can be seized with forceps and pushed upwards until the lower extremity is free, and then extracted; or may be divided before being removed with cutting pliers. Occasionally a cylindrical speculum is necessary, as in the case of a fork, in order to protect the mucous membrane. When the body is hooked it must be extracted by the hand or divided by a saw, the rectum being protected by a gorget.

CHAPTER XXXI.

HERNIA.

By a hernia is meant the protrusion of an internal organ, covered by integuments, from its containing cavity, without there being any external wound.

Abdominal Hernia may be met with at almost any part of the abdominal wall, but most frequently occurs where openings naturally exist for the passage of blood-vessels.

Structure.—A hernia consists of two parts, the sac and its contents.

The Sac is formed of peritoneum, which is either pushed forward by the gut as it enters the aperture (acquired hernial sac), or already exists as the

vaginal process of peritoneum, forming a serous canal or pocket into which the hernia escapes (congenital hernial sac). In exceptional cases the sac may be absent, as in organs which are not normally completely enveloped in peritoneum,—such, for example, as the cæcum, colon, or bladder,—and in cases of rupture of the sac by violence or ulceration. Two sacs may be present, constituting a double hernia, both having been protruded through the same aperture. One sac may be behind or within the other; occasionally the sac is bifurcated. The sac consists of two parts, the neck and

the body. The *neck* is the narrow, constricted portion, often thickened and opaque, which is surrounded by the edges of the natural or accidental opening at which the hernia manifests itself. The *body* is external to the abdominal cavity, and is of a more or less globular form, varying in size from a cherry to a cocoa-nut, or larger; as a general rule, the smaller the sac the more recent the hernia. The body is thin at first, but in old herniæ becomes thickened, opaque, and dense. The sac soon contracts adhesions to its coverings from inflammatory action, and then cannot be returned within the parietes of the abdomen. It increases with the size of the hernia, chiefly by fresh protrusion of adjacent peritoneum, but partly by increased growth, and partly by distension and separation of its fibres.

The *Contents* vary greatly. Most frequently they consist of a small quantity of fluid and a portion of bowel, generally the small intestine, and especially the lower part of the ileum (enterocele). The large intestine is but rarely included, though the cæcum and vermiform appendix are sometimes met with. Omentum often accompanies the intestine (entero-epiplocele); it may alone descend (epiplocele). In an entero-epiplocele the gut is sometimes completely surrounded and enveloped by omentum, which may thus produce strangulation; in other cases the omentum forms a complete bag or sac. Other organs beside intestine have been met with forming the contents of a hernial sac, as the stomach, gall-bladder, liver, spleen, ovaries, bladder, and uterus.

In old herniæ, adhesions often form between the coils of contained viscera, or between the wall of the sac and the intestine or omentum.

Hydrocele of the Hernial Sac is a very rare sequel; it occurs in an old hernia, from the fluid collecting at the bottom of the sac, all communication with the peritoneal cavity being cut off, either by the radical cure of a rupture, or the adhesion of omentum or gut to the upper part and neck of the sac.

Causes of Hernia. — Predisposing.
1. Sex: Men are much more frequently affected with this disease, especially the inguinal variety; femoral and umbilical herniæ are more common in women, being seldom met with in the male.
2. Age: In the male it is often met

with in infancy, decreasing in frequency until the thirteenth year, and then progressively increasing. 3. Occupation: Those employments necessitating violent muscular efforts are conducive to the formation of a hernia. 4. Hereditary predisposition, particularly as affecting the closure of the vaginal process of the peritoneum, and producing an elongated condition of the mesentery. 5. Unusual laxity of the muscular structures of the abdomen, which may be occasioned by pregnancy, ascites, obesity, tumours, tight lacing, etc.

Exciting.—Unusual forcible efforts, in which the diaphragm is inordinately contracted, as in lifting a heavy weight, straining at stool, the expulsive efforts of parturition, jumping, coughing, vomiting, difficult micturition the result of stricture, etc. Occasionally a rupture is produced as the immediate consequence of external violence, as a blow or wound.

A hernia may be: (α) Reducible; (β) Irreducible; or (γ) Strangulated.

(α) *Reducible Hernia.*—When reducible a hernia can be completely returned into the abdomen by properly applied pressure.

Symptoms. — 1. A soft, somewhat elastic swelling, compressible with the fingers, painless and without undue heat, and having a neck fixed firmly to the abdominal walls. It increases in size on standing upright, when working or coughing, or after a heavy meal. 2. It imparts a distinct *impulse* to the surgeon's finger when the patient coughs. 3. On percussion, if the sac contain intestine it emits a resonant hollow note; but should the bowel contain fæces, it yields on percussion a dull note, and may be hard, smooth, elastic, and continuous. Omentum also gives a dull note, but is soft, flabby, and doughy, irregular, nodulated, and without an impulse. 4. During recumbency, if the hernia be formed of intestine, on manipulation it passes up easily, smoothly, and suddenly, with a *distinct gurgling noise*, and on pressing the finger over the ring will not return. If the intestine contain fæces, its shape is altered on handling, and it returns slowly and almost without noise. When omental the rupture is reduced without gurgling, gradually, and often with difficulty.

Treatment.—Reduce the hernia by the taxis applied in the manner appropriate

to the particular variety, and apply a truss.

With regard to trusses, there are any number, each maker professing to excel the rest in various points of superiority. The considerations to be attended to are: 1. Accurate fit; 2. Sufficient strength to prevent the rupture coming down; 3. The surface of the pad must be as nearly flat as possible; 4. The pad must press on the walls and sides of the hernial canal. Wood's *horse-shoe pad* is excellent for inguinal hernia; he also uses a ring pad for cases of direct inguinal hernia, and an egg-shaped pad for femoral hernia.

To Measure a Person for a Truss.—In the inguinal form, take the circumference of the body round the hips (between the crista ilii and great trochanter), and measure the distance between the symphysis pubis and anterior iliac spine, half of which distance is the position of the internal abdominal ring. For femoral hernia, besides the circumference round the hips, the distance of the saphenous opening from the symphysis pubis and anterior iliac spines should be given. The truss should always be put on and off when the patient is lying down. In order to harden the skin under the pad of the truss, it should be bathed with alcohol containing powdered alum. To ascertain if the truss fit, the wearer must separate his legs, lean forward over the back of a chair, and cough or strain; should the rupture keep up, the instrument is a good fit. Every person having a hernia should have two trusses, so that on any accident occurring to one, he can wear the other whilst it is repaired; many persons have lost their lives for want of this precaution.

(β) *Irreducible Hernia* is one in which the contents cannot be returned into the abdominal cavity. It is usually of long standing, and large size, containing omentum and gut.

Causes.—1. Outside the sac: Contraction of the opening in the wall of the abdomen; contraction of the peritoneal cavity. 2. In the sac-wall: Constriction of the neck of the sac; hour glass contraction of the sac; formation of membranous bands across the sac; herniæ of the cæcum, sigmoid flexure, and bladder, when they have no sac, are irreducible; adhesions between the sac and its contents. 3. Sac-contents: Alteration of form and deposit of fat in the omen-

tum; great bulk of the hernia; adhesions of the protruded parts to each other; presence of much fluid in the sac; sudden descent of a large amount of intestine or omentum; and impaction of the bowel with faecal matter.

Symptoms.—A colourless, elastic tumour, which is often resonant on percussion. Habitual disorder of the digestive organs, with colicky dragging pains, sensation of weakness, constipation, flatulence and other dyspeptic symptoms. It is apt to be obstructed and then become strangulated; and is also liable to be injured by external violence.

Treatment.—The indications are: 1. To render the hernia reducible if possible; 2. To prevent it increasing in size; 3. To treat the dyspeptic symptoms. To make the rupture reducible the patient is kept in bed, on a spare diet, and ice applied to the swelling. Purgatives, as sulphate of magnesia, jalap, or enemata, are necessary. Pil. hydrarg. and antim. potass. tart. internally for some time, followed by iodide of potassium. To prevent increase in size, the hernia is supported by a truss, with a concave pad, moulded on a plaster cast of the hernia; or if too large for this, by a suspensory bandage. The third indication is obtained by attention to the bowels and diet.

Inflamed Irreducible Hernia is one in which the coverings are attacked by inflammation. It usually occurs as the result of some injury, and is most apt to present itself in a hernia containing omentum.

Symptoms.—The swelling is red, hot, swollen, indurated, and painful, but there is no tension at its neck. The skin is often œdematous. The patient is feverish and symptoms of peritonitis soon set in, at first local and circumscribed, afterwards general: vomiting may be present, *but is never feculent*. Constipation is rarely complete, flatus and some fluid faeces passing. This condition may result in suppuration, but as a rule, resolution takes place.

Treatment.—Absolute rest in bed; leeches to the sac, and ice or Leiter's tubes. Calomel and opium internally. To relieve the bowels, enemata. A scanty fluid diet is necessary.

Incarcerated or Obstructed Hernia is the term applied to the accumulation and impaction of partially digested food,

faecal matter, and flatus in a hernia, producing temporary obstruction. This accident usually occurs in old people who have long suffered from an irreducible hernia.

Symptoms.—Constipation, often not complete, with eructations and sometimes vomiting. No tension of the tumour. Slight pain, sense of weight and uneasiness, dragging sensation at the umbilicus. Colicky pains and eructations with flatulent distension of the abdomen. There is no marked constitutional disturbance.

Treatment.—Rest in bed. 1. Clear out the lower part of the bowel by an enema of turpentine and castor oil, or a compound colocynth enema, thrown up through a long tube. 2. If not relieved, apply ice to the tumour, and then the taxis under chloroform to empty the contents of the swelling. Occasionally hot fomentations are preferable to ice, and the patient's feelings should be consulted in this matter. 3. Afterwards calomel, or croton oil and colocynth, should be given. Spence writes, with regard to doubtful cases of strangulation: "*When in doubt, operate.*"

(γ) *Strangulated Hernia* is one which is not only irreducible, but somewhere about its neck is so tightly constricted that the circulation of the gut is impeded, which produces congestion, and unless relieved runs on to gangrene. Strangulation may occur at the first descent of a hernia from the pressure of the aperture; or this may occur in cases of old standing from another portion of bowel being forced into the sac.

Symptoms.—Local. A tense swelling which cannot be reduced. Pain commencing at the neck of the hernia. No impulse or increase of size on coughing. —General. Absolute constipation and nausea, followed by vomiting, which is at first gastric with some bilious matter, and then intestinal or stercoraceous, resembling in colour and odour a mixture of faeces and water. The higher the seat of constriction the quicker does vomiting occur. Two theories are stated to account for the causation of vomiting. 1. That this is due to reversed peristaltic action. 2. That increased and violent peristaltic action causes a circumferential downward current and a central upward one. Colicky and dragging pains at the abdomen. Great

thirst. Constitutional depression progressing to a state of a collapse. This is followed by symptoms of peritonitis. Tense and swollen state of the abdomen; tenderness and lancinating pains about the belly and tympanites. The patient lies on his back with the knees drawn up. The pulse is at first full, but afterwards frequent, hard, and wiry; a pulse of 120 denotes danger. The tongue is dry and brown, tremulous, and protruded with difficulty. The countenance assumes the Hippocratic aspect, being shrunk, collapsed, pale, and anxious, with dark lines under the eyes; the extremities are cold as ice. The urine is scanty and of high specific gravity; the chlorides are diminished in amount, and when strangulation has lasted some time, albuminuria is present. On the onset of gangrene, hiccough; cold, clammy perspirations; feeble, irregular, and fluttering pulse; and sudden cessation of pain in the tumour appear. The period at which death occurs is generally from three to five days.

In old-standing cases the symptoms are slighter and may be overlooked. In small herniæ, especially femoral, the local symptoms may be very slight; should there be much omentum in the sac, the tumour, even though strangulated, may feel soft and loose. It is to be noticed that if a small knuckle of intestine in a large hernia be strangulated by adhesions within the sac, there may be still an impulse on coughing. Vomiting in rare cases may be slight, absent, or non-feculent. Opium, when given, masks the symptoms. In strangulated omental hernia the symptoms are slighter, and often the constipation is not absolute. Symptoms of rare occurrence are congestion of the lungs, cramps in the limbs, delirium, and in children convulsions.

Seat of Stricture.—This is usually at the neck of the sac, either outside in the tendinous structures surrounding it; in the wall of the sac at the neck or body; and occasionally inside the sac, the gut being constricted by bands, or by omentum. In some cases the bowel becomes twisted on itself within the sac, forming a volvulus, and thus occasioning strangulation.

Effects on the Gut.—(1st Stage.) *Congestion.* The bowel is of a claret

or purplish brown colour; the surface of the intestine only slightly ridged along the line of the vessels, the coats a little swollen and puffy, and the sac contains a straw-coloured hernial fluid. The tumour is tense and firm, tender when handled, irreducible, and without impulse on coughing. Pain is experienced of an aching or dragging character; the patient lies on his back with the knees drawn up; anxious expression; commencing feeling of nausea; thirst.

(2nd Stage.) *Inflammation.*—The sac increases in size; the hernial fluid contains flakes of lymph, and is of a rosy colour. The surface of the gut is roughened, coated with flakes of lymph, feels sticky to the finger, and is of a dark purple colour. Patches of extravasated blood are often present in the subserous connective tissue. The coils are often more or less united; the coats of the gut thickened and œdematous; the omentum intensely congested. The tumour is hard and tight; the patient unable to lie with his legs extended; local tenderness on slight percussion. The dragging pains are increased. Tympanites, increased colic, and general symptoms of peritonitis.

(3rd Stage.) *Gangrene.*—The sac is elastic and more or less flaccid; the contents, of a dark port-wine colour, containing blood, coagula, pus, flakes of lymph, and portions of omentum, are very offensive; surface of the gut very rough, having lost its lustre, elasticity, and polish, of an ashy grey or dull black colour, soft and easily torn. The bowel is often ulcerated at the seat of stricture, and the intestine fixed to the mouth of the sac by adhesions. The omentum is dark purplish. The integuments over the hernia are of a dusky red, œdematous, and finally emphysematous crackling sets in, which is a sure sign of gangrene. The general symptoms of gangrene fever supervene. If the progress be not arrested, gangrene of the skin takes place, the sac giving way, and an artificial anus results.

Effects of the Strangulation on the part of the Intestinal Tract not involved in the Hernia.—The portion between the stomach and the hernia is distended with flatus and dark brown fluid. The mucous membrane congested; the serous membrane also congested and mottled with red patches. The muscular

coat loses its power of contractility. The part below the hernia is anæmic and contracted. Appearances due to peritonitis may be present.

Diagnosis requires to be made from: “1. Obstructed irreducible hernia.—In this there are no acute symptoms, and the rupture will generally be found to be a large one of old standing. It may be tense and swollen, but is not tender to the touch, and always presents some impulse on coughing. There is no sign of peritonitis. There may be constipation; there is no vomiting, or, if present, it is simply the contents of the stomach. The result of appropriate treatment will remove any doubt as to the nature of the affection.

2. Inflamed irreducible hernia.—Here are great tenderness and pain in the tumour, with pyrexia, and some general peritonitis, but no vomiting; or if the patient have vomited once or twice, he does not continue to do so with the same violence, or in the same quantity as he would if the peritonitis were the result of strangulation. The constipation is not complete, flatus and liquid fæces passing.

3. General peritonitis conjoined with hernia.—Here the diagnosis is often extremely difficult, especially if the hernia be an irreducible one. In these cases, however, it will be observed that the peritonitis may be most intense at a distance from the sac; that there will be little or no vomiting, or if there be it is simply of mucus and the contents of the stomach, and that the constipation is not insurmountable by the ordinary means.

4. In double hernia, one tumour may be strangulated and the other not, though irreducible. In these circumstances it may at first be a little difficult to determine which is the seat of the constriction. This, however, may be ascertained by observing the greater tension and tenderness about the neck of the strangulated than of the unconstricted hernia. [In a female with an inguinal and femoral rupture, accompanied by symptoms of strangulation, if the surgeon cannot diagnose which hernia is the source of trouble, he should operate on the femoral first.]

5. The co-existence of *early pregnancy*, or a *threatened miscarriage*, may obscure the diagnosis. Here it may be stated

generally that the vomiting of pregnancy never becomes stercoraceous; that constipation, if it exist, does not resist the action of aperients or enemata; and that the local signs of strangulation are usually well marked (Erichsen)."

Treatment.—The first measure at our disposal is the taxis, or reduction of the hernia by the use of the hands. The patient should be placed on his back with the shoulders low, hips raised by a pillow under the buttocks, and the thigh half bent on the abdomen and adducted. The fingers of the left hand are placed on the neck of the hernia; the right hand spread out grasps the tumour, draws it down, and then pushes it in the line of its descent with a kneading motion. In thin persons the return of the hernia may be facilitated by putting the tip of the finger under the edge of the ring and pulling it firmly to one side. Dr. Allen, of California, uses a special dilator for the same purpose. The utmost gentleness must be used or the gut will be bruised; after the intestine has been strangulated twenty-four hours, it is liable to become gangrenous or burst from manual pressure, or cut against the edges of the hernial aperture; death resulting from faecal extravasation or the formation of an artificial anus. If the bowel burst it glides away from the finger, and the tumour disappears without gurgling, followed by intense pain in the abdomen, retching, and hiccup; the soft tissues become puffy and emphysematous, and occasionally a faecal odour is distinctly perceptible. The taxis should not be tried for more than half an hour. Hey writes: "The smaller the hernia, the less hope there is of reducing it by taxis." Wood recommends in cases of difficulty the *inverted position*. This is best and most quickly accomplished by drawing the patient, with the upper part of the mattress, bed, and bedding, off the side of the bedstead, and placing them on a low stool or on the floor, keeping the patient's hips on the side of the bedstead with the knees still drawn up. To aid the return of the bowel, an assistant presses gently with his hand on the abdomen near the rupture, sliding it slowly from the strangulated part while the patient makes a slow and deep inspiration. In all difficult cases chloroform, or the A.C.E. mixture (alcohol 1

part, chloroform 2 parts, ether 3 parts), is of the greatest service; and before the patient is anaesthetised the surgeon should obtain his permission, and be prepared to operate, if the taxis fail. The ether spray on the tumour is sometimes an assistance, as is also puncture of the gut with the needle of a hypodermic syringe. The subcutaneous injection of m x of sulphuric ether over the seat of the hernia is often of service in aiding the taxis, but is liable to produce sloughing of the skin. The taxis must not be used if symptoms of gangrene be present, or the hernia be inflamed, and in femoral hernia where the vomiting is faecal. In old-standing cases give an enema of gruel and castor oil, with some spirits of turpentine; or ol. olivæ O iv, ol. ricini, ol. tercbinth. āā fʒiij. These should be injected through a tube nine or ten inches long, and passed high up into the gut. Then apply a bladder of ice to the tumour for three or four hours, and under chloroform attempt the taxis.

After-treatment.—Rest in bed for a few days; locally, a sponge pad and a spica bandage. Strong liquid diet, no aperients. If there be much pain, belladonna and opium suppositories, or the injection of morphine combined with atropine hypodermically.

Symptoms remaining after Reduction.—This may occur from one of four conditions: 1. The hernia may have been reduced *en masse*; 2. An internal strangulation may have existed within the sac; 3. The constriction suffered by the hernial contents eventuates in gangrene or acute peritonitis; 4. There may be another hernia, which is also strangulated.

In the case of *reduction "en masse"* the tumour slips up without any gurgle; all trace of a sac has disappeared, and the canal is very patent; on coughing, sometimes a rounded swelling can be felt at the upper part of the canal.

When *internal adhesions* are present, there is no gurgling, but the sac is easily perceived, and the canal is not unusually open.

In the case of *extreme nipping*, gurgling is felt and heard, and the obstruction is not complete, the vomiting ceasing to be stercoraceous, and flatus passing. If acute peritonitis supervene, there will be diffused and acute ten-

derness, tympanites, rise of temperature, etc.

When a second strangulated hernia co-exists, a careful examination of the other usual sites of hernia will show the nature of the case.

Treatment.—When the symptoms remain after reduction for some hours, the surgeon should cut down upon the canal and expose the sac, dividing then any constriction. The wound is left open, with a poultice and light compress over it. If the bowel be thought to be gangrenous, perform laparotomy, and make an artificial anus.

When the taxis has been fairly tried with all auxiliary measures, and reduction cannot be achieved, the operation of herniotomy is necessary. In small recent herniæ it is not advisable to wait more than two hours before operating; in old large protrusions eighteen hours is the limit. In all cases where the vomiting is stercoraceous, it appears to be the best course to operate *at once*, without wasting time in trying the taxis or anything else.

Herniotomy.—Instruments required.—1. Scalpel. 2. Straight bistoury. 3. Probe-pointed bistoury. 4. Hernia knife. 5. Narrow director. 6. Broad director. 7. Dissecting forceps. 8. Blunt hooks. 9. Fine hook. 10. Artery and torsion forceps. 11. Catgut ligatures. 12. Sutures. 13. Scissors. 14. Drainage tube. 15. Lint and absorbent cotton. 16. Plaster. 17. Roller. 18. Compress. 19. Razor. 20. Sponges. 21. Morphia suppository. 22. Materials required for aseptic method (*vide* Wounds). 23. Anæsthetic and inhaler.

Position.—The patient is placed on his back, with the shoulders raised, and the knee of the side affected slightly bent. The groin must then be shaved, and chloroform given.

Operation.—An incision is made by lifting up a fold of skin and cellular tissue at right angles to the hernia, and running the knife through its base, with the back turned towards the sac. If this incision be not long enough, it is enlarged at each end; the beginner will find a great advantage in the subsequent steps if he have a large external wound. Any bleeding vessel must be at once secured. The next step is to expose the neck of the sac. The thickness of connective tissue covering it varies much;

each layer is to be carefully pinched up with dissecting forceps, and opened with the knife turned on its flat, a director introduced, or the finger, and the structures divided to the full extent of the external incision. Thus layer by layer is divided until the sac be reached, and recognised by its membranous character, rounded and tense appearance, and by the arborescent arrangement of the vessels on its surface. If small and recent, the sac may be known by its bluish colour, and it being possible to pinch up a fold and rub the surfaces against each other. If large and of old standing, the sac may be very thin, or in other cases extremely thickened and adherent. When of small size it should be thoroughly isolated, and its boundaries everywhere defined; if large and adherent, its neck alone should be cleared. The surgeon must remember that in certain cases there is no sac, or only a partial one; in other cases a cyst developed in the connective tissue lies in front of the sac; lastly, the sac may be adherent to its contents. Having reached and recognised the sac, the surgeon must endeavour to return the hernia into the abdomen without opening the sac. The finger is passed up to the neck, and any constricting band divided by means of a hernia knife or blunt-pointed bistoury carried flatwise along the finger, and turned on its edge when the stricture is reached, making two or three nicks in the part. The taxis is then applied, and a few sutures, pad, and bandage.

The sac need not be opened where strangulation has only lasted a few hours, and there has not been severe vomiting of a stercoraceous character, or extreme prostration; the hernia is a simple enterocele; and taxis has not been forcibly or continuously applied.

The dangers of not opening the sac are that the intestine may be gangrenous, or the stricture situated within the sac, and the intestine may be returned unrelieved.

The sac must be opened: 1. Whenever there is good reason to fear the bowel is gangrenous; 2. Where there has been long continued vomiting or tenderness on pressure; 3. In cases of marked prostration; 4. In entero-epiplocele; 5. If repeated, forcible taxis have been used; 6. Whenever the hernia cannot be completely returned into the abdomen;

7. In all instances where the hernia is very small.

Opening the sac.—When small, the sac should be opened at the lower part; a small portion of the wall is pinched up and divided in the same manner as the superficial layers. If the sac be very tense, it is best opened by carefully introducing the point of a fine hook into its substance, raising up a portion, and making the aperture. A variable amount of serous fluid will escape, and the glistening surface of the bowel be seen; the finger is then introduced, or the director, and the incision enlarged with a probe-pointed bistoury.

Division of the Stricture.—The forefinger of the left hand is passed up into the neck of the sac to the stricture, with the pulp upwards; the finger nail is inserted under the stricture, and a probe-pointed bistoury or hernia knife passed on the flat along the palmar surface of the finger. Its edge is then turned up, and the constriction divided in the proper direction, from an eighth to a quarter of an inch.

Examination and return of the Bowel.—The bowel is now drawn down from the seat of obstruction for about an inch, to bring into view the constricted part, for the purpose of examining whether the return of the bowel can be practised with propriety. A great change in the colour of the gut may occur from congestion, without it being gangrenous. A deep red, claret, or purple, does not preclude recovery, especially if the blood vessels refill after gentle pressure between the thumb and finger. When the bowel is black or a dark brown it is probably gangrenous; also, if there be greyish or ash-coloured spots on the bowel, even though small, it is likely to be gangrenous. So long as the surface has not lost its glistening appearance, even when it is of a bad colour, it may recover; but if it be dull, flaccid, granular, wrinkled, or soft like wet paper, it is certainly gangrenous. A gangrenous or faecal odour on opening the sac is a positive assurance of mortification. Gross writes: "To determinethisquestion, one of the most serious which can arise during this operation, the intestine, after having been thoroughly liberated, should be fomented with a sponge or cloth, wrung out of warm water, and steadily maintained in contact with it for ten,

twelve, or fifteen minutes; if at the end of this time it be found that there is no change in the appearance of the protruded knuckle, denotive of a return of its circulation, it will be proper to puncture some of its vessels, or even to scarify the bowel slightly at a few points." When sufficiently healthy, the intestine must be replaced as gently as possible by pushing it back with the index finger, and afterwards the omentum. Having examined the canal to see it is clear, a suture or two is passed through the edges of the wound, a drainage tube inserted, and an aseptic dressing with a spica bandage applied. After the third day the tube may be removed.

It is a good practice if the sac have to be opened to dissect it out, stitch up the neck and hernial openings with silver sutures, and remove the fundus; another plan, introduced by Mr. C. B. Ball, has been used with success, namely, torsion of the sac, the latter being cleared from the surrounding parts, and twisted several times at its neck. The sac is best separated by the fingers and one or two pairs of forceps, or the handle of the scalpel. The chief danger in the inguinal variety is to the spermatic vessels and duct, which may be closely adherent to the inner and hinder surface of the sac, and covered by a thick fascia closely connected with the sac. The attachment to the tunica vaginalis is now and then so close that the testis may be extruded and the tunica opened by mistake. The sac is lifted up and detached from the cord as high as the deep ring. In the congenital form the part of the sac which should have formed the tunica vaginalis and is adherent to the testicle should be separated from the rest at the level of the upper part of the testicle, and stitched with fine catgut in a continuous suture. Wood recommends that a pair of straight dressing forceps should be placed across the sac at the place indicated, then the sac sewn with catgut, and afterwards cut off straight above the suture.

Accidents in the Operation.—1. Wound of intestine. 2. Wound of artery, which must be cut down on and tied. 3. Inflammation and suppuration of the sac. 4. Sloughing of the sac.

After-treatment.—The patient must be kept in bed, and have an opiate given to him. The bowels generally act in a few

hours, but if they do not within four or five days, a mild enema of castor oil and gruel should be administered. *No purgatives must be given.* For the first day, barley-water and ice, brandy if necessary; afterwards, milk, which may be iced, beef tea, but no solid food until the bowels have acted.

Peritonitis after Herniotomy may be either acute, occurring in strong, healthy individuals, or latent, in old, feeble persons.

Acute Peritonitis is similar to that present after injury or wound of the intestines (*vide* chap. xxx.).

Latent Peritonitis occurs without any or only slight local symptoms.

Symptoms.—Two or three days after operation there are accumulation of gas, rapid and flickering pulse, cold perspirations, hiccough, pinched face. The abdomen is filled with a turbid serous fluid or pus, and the intestines adherent and covered with lymph.

Treatment.—Opium in gr. j doses every three hours. Counter-irritation by blisters dressed with mercurial ointment. Turpentine enemata for tympanites. The diet must be supporting, brandy and egg mixture, milk, beef tea, etc.

Treatment of Intestine.—When the intestine has been very tightly nipped and is marked by a distinct hollow, and is dark and congested, it generally becomes gangrenous, even though it may not appear so at the time of the operation. It is best, therefore, after dividing the constricting band, to leave the bowel outside the ring, covered with lint dipped in warm water, the heat being maintained by a sponge wrung out of hot water placed outside the lint. Bryant, however, advises, in doubtful cases, the return of the bowel into the abdomen.

Should the gut be undoubtedly gangrenous, *the stricture must be divided, but the bowel must not be returned*: the gangrenous portion must be left outside, so that adhesive inflammation may fix the intestine to the abdominal wall, and form an artificial anus. The gangrenous part should not be incised, but the sac and the parts over it freely exposed, the wound being left open and covered with a poultice. In most cases it is advisable to make sure the bowel does not slip back by stitching it fast to the sides of the incision.

Resection of the gangrenous part of the

bowel may be tried in suitable cases; sections being made through the gut, including the damaged loop between them. The mesenteric attachment is divided, all vessels being tied with catgut ligatures. The cut healthy sections of the bowel are united by Lembert's, Jobert's, or the continuous suture, and returned into the abdomen; the external wound closed with aseptic dressing, and a drainage tube passed into the abdomen at the lower angle of the wound. When the piece of bowel removed exceeds half an inch, a V-shaped portion of mesentery must be removed as well. The cut edges of this should be first sutured. The ends of the divided bowel must be held between the finger and thumb, or secured by clamps covered with india-rubber.

If the reduction of intestine be prevented by accumulation of gas, the bowel should be punctured with a fine trocar.

Treatment of Omentum.—If only a small amount of omentum be present in the sac, and this be healthy and in good condition, it is to be returned after the bowel. But if there be much of it; if it be hypertrophied, indurated, or altered in structure; if it be adherent to the sac and congested; or if it be inflamed, suppurating or gangrenous (epiploitis), it must not be returned. The discolouration of an inflamed omentum is always less than that of a similarly affected bowel, but there is always well-marked loss of consistence. When inflamed or gangrenous, excision is necessary, the omentum having been previously carefully unrolled and examined to see that it does not contain any intestine. Excision is performed by securing the base as near the neck as possible with the fingers, transfixing it with a strong catgut ligature, tying this securely on each side, and then cutting off all the mass below the ligature and returning the cut end into the abdomen. Some surgeons prefer clamping the omentum beyond the gangrenous part, excising it with scissors, and securing each vessel separately with catgut. The omentum should also be excised if it be much enlarged or hypertrophied, rendering replacement difficult.

Treatment of Adhesions.—If the adhesions be recent, depending on a coating of freshly deposited lymph, they can be broken up with the finger or handle of the scalpel, and the parts returned. If the adhesions be firm and old, but narrow,

they must be divided with the hernia knife, and the hæmorrhage arrested by clamping for a few moments, or touching the bleeding points with the thermocautery. When the attachments are very broad it is best to leave them untouched, and the attached bowel and omentum unreduced, having emptied the bowel of its contents. Should adhesions be present between the omentum and intestine or mesentery, in the form of narrow firm bands, a director must be passed underneath, and the connexion divided with a probe-pointed bistoury, or if this cannot be accomplished, the forceps and scalpel must be employed to dissect it off.

Artificial Anus and Fæcal Fistula.—When an unusual opening exists in the intestine, by which all its contents escape externally, it is called an *artificial anus*; the internal orifice, involving the whole or the greater part of the lumen of the bowel, is adherent to the parietal peritoneum opposite the opening in the skin. If only a small quantity of the bowel contents escape through a narrow tract or channel, it is termed a *fæcal or intestinal fistula*. The causes of this occurrence are hernia, wounds of the intestine, or ulceration and perforation of the bowel. The most common form of artificial anus consists in the serous surface of the bowel being united by lymph to the abdominal wall. The adhesions are generally from one-twelfth to one-fourth of an inch wide; but in old cases, from constant dragging of the mesentery, the adhesions yield, and the gut becomes free and floating. The upper and lower portions of the bowel, though lying at first almost in a straight line, soon form a more or less acute angle; the lower portion becomes atrophied and narrow, the upper dilated. The mesenteric surfaces opposite the opening are pressed forward into it, and form a sort of valve or spur (*éperon* or promontory) between the two apertures, which prevents the current of fæces from entering the lower division of the bowel, and directs it out through the cutaneous aperture. The spur, after some time, does not occupy the centre of the artificial anus, but is bent down towards the lower part of the bowel by the constant passage of fæces through the upper opening, and thus gradually closes communication with the lower one. The integuments become excoriated and inflamed from the passage of fæces; the

mucous membrane is everted, and when the orifice is large, prolapsed. In other cases the angle formed by the gut adheres to the upper extremity of the sac, which has been returned; thus the fæcal matter traverses a long canal before it reaches the external aperture. In a third variety the spur is fixed at a point in the abdomen at a higher level than the cutaneous opening, and the fæces find their way through a passage formed by lymph-bound coils of gut. In the case of a fæcal fistula the opening in the bowel is very small, allowing a quantity of thin fluid feculent matter to exude. There may be several apertures in the skin communicating with the gut, and also several openings in the bowel. If the discharge consist of well-formed fæces, the opening is situated at the lower part of the small intestine or in the large intestine; when thin and not offensive-smelling, in the jejunum; if yellow and semi-feculent, in the ileum.

Complications.—1. Prolapse of the superior orifice, even to the extent of a foot or more. 2. Prolapse of the inferior orifice. 3. Prolapse of both orifices. 4. Presence of a hernia between the orifices.

Treatment.—When the opening is small and the communications between the portions of the intestinal canal lying above and below it free, the recumbent posture and the pressure of a pad by means of a truss will often close the aperture. Desault advised a firm compress of oiled linen containing a heavy piece of sheet lead. Colomb's plan in artificial anus consists in uniting the upper and lower ends of the gut by a curved elastic tube two or three inches long. Should there be a number of sinuses or fistulous passages in the walls of the abdomen, they must be freely laid open on a director, except the one most directly connected with the gut, followed by the application of caustic or cautery. As a rule, when an artificial anus exists operative measures are necessary. The spur must be removed by Dupuytren's enterotome, which by steady and gradually increasing pressure produces sloughing of the *éperon* and adhesion between the adjacent peritoneal surfaces, cutting its way through in from four to seven days. Then the external aperture is pared and closed with hare-lip pins and sutures. If the cutaneous orifice will

not close by these means, the mucous membrane lining it must be dissected up to the peritoneum, and its raw surfaces united with sutures. Liberating incisions are made through the skin and tendon of the external oblique, the sides of the opening repaired and brought together; or lateral flaps with both ends still adherent may be made and united by their sides along the centre of the opening. If the enterotome be not successful; if the precise condition of the bowel cannot be ascertained; when there is crossing of the ends of the bowel, great irregularity of calibre, or several perforations near together; in cases of extensive prolapse; and lastly, when there is no spur and the external opening is too large to be united by suture, a free incision is made in the abdominal wall, the fistulous openings in the bowel fully exposed and separated; the adherent portions of the intestine are completely removed and the severed ends of the gut carefully sutured together; the bowel being then returned into the abdomen.

Reduction in Mass consists in the hernia being apparently reduced with its sac into the abdomen, but the strangulation still persists. This may be due to four kinds of accident.

1. The sac being pushed back entire into the abdominal cavity whilst the hernia is still strangulated by the neck of the sac (very rare).

2. *By Laceration.*—The sac being ruptured at its posterior part, the hernia, still strangulated by the neck of the sac, is driven through the rupture into the subperitoneal tissue. This accident occurs only in the inguinal varieties, especially the congenital; in many cases it happens from the patient's own efforts at reduction, and is due to the adhesions between the sac and the surrounding tissues being very slight.

3. *By Displacement* (Charles Bell's form).—The neck of the sac is detached from the internal abdominal ring by force, and is then freely movable. On attempting reduction, the hernia does not escape from the sac, but both the sac and hernia are pushed through the external ring, spermatic canal, and internal ring within the abdominal muscles, but not within the peritoneum. The neck of the sac still firmly constricts

the bowel, the duplicature of peritoneum upon the inside of the neck of the sac is unfolded, forming a new sac for the bowel on the inside of the abdominal muscles.

4. *Intra-parietal with Herniated Neck of the Sac* ("Hernie en bissac").—An offshoot of the sac is here present in the anterior abdominal walls either upwards, outwards, or inwards; behind the muscles and in front of the fascia, or in front of the muscles under the skin. The hernia, when reduction is attempted, disappears from its usual sac and fills up the offshoot, but is, of course, strangulated at its neck.

Symptoms.—1. Continuance of symptoms of strangulation. 2. Hernia does not return with a sudden jerk and gurgle. 3. Disappearance of usual fullness, due to the presence of the sac. 4. Abdominal ring large, rounded, and unusually open. 5. Occasionally on passing the finger into the ring the hernia can be detected.

Treatment.—Make an incision to expose the ring and open the canal; if the sac be absent, but the thickened subperitoneal tissue be present, the surgeon may be sure this accident has happened. The finger is to be passed into the internal ring, and the hernia searched for behind the abdominal wall; when found it must be brought down by enlarging the ring, the sac opened, the stricture divided, and the contents treated as usual. If the hernia cannot be disengaged and restored to its proper position the patient must make a straining effort by coughing to reproduce the hernia; should it still not come down, it must be operated on within the abdomen with a sheathed bistoury.

Special Herniæ.

Inguinal Hernia is a hernia occupying the inguinal canal, and is most frequent on the right side.

Varieties.—1. Oblique, also called external (*i.e.*, to the epigastric artery), or common. 2. Direct or internal. 3. Congenital. 4. Encysted.

Oblique Inguinal Hernia protrudes through the internal abdominal ring, passes down the inguinal canal in front of the spermatic cord, and out by the external ring. When in the canal it is termed a bubonocoele, and if it reach the scrotum a scrotal hernia or oscheocoele;

when it enters the labia in women, the name pudendal is applied.

Coverings.—From within outwards: 1. Peritoneum, forming the sac; 2. Subperitoneal cellular tissue; 3. Transversalis or infundibuliform fascia, called also fascia propria; 4. Cremasteric fascia; 5. Intercolumnar fascia; 6. Superficial fascia; 7. Skin.

Relations.—The spermatic cord is behind the hernia; very rarely the cord may be split up, the vas deferens lying on one side of the hernia, and the spermatic vessels on the other; still more rarely the cord lies wholly or partially in front of the rupture. The testicle is below and behind the hernia. The epigastric artery lies behind the hernia, and turns upwards and inwards round the inner side of its neck.

Direct Inguinal Hernia is that form which, instead of traversing the internal abdominal ring, makes its way through Hesselbach's triangle; this space is bounded by the epigastric artery externally, by Poupart's ligament below, and by the sheath of the rectus internally. The hernia emerges at the external abdominal ring. The rupture may escape through the middle fossa of Hesselbach's triangle between the epigastric artery and the obliterated hypogastric; or through the inner fossa between the obliterated hypogastric and the outer edge of the rectus. In the former variety, as the middle fossa is close to the internal ring, the hernia will have the same coverings as in the oblique variety, with the exception of the infundibuliform fascia, which is replaced by fascia transversalis. This hernia is never congenital.

Coverings.—1. Peritoneum. 2. Subperitoneal tissue. 3. Fascia propria, or fascia transversalis. 4. Conjoined tendon (this is often absent, as the hernia frequently ruptures it). 5. Intercolumnar fascia. 6. Superficial fascia. 7. Skin.

Relations.—The spermatic cord is outside the hernia, the epigastric artery is external, but also arches over the neck of the sac.

Symptoms.—A bubonocoele produces a fulness in the canal on standing or coughing, with an impulse on passing the finger into the canal and directing the patient to cough. An oblique inguinal hernia causes a tumour of an oval shape, with the characters of a hernia, and

taking a direction downwards and forwards. A direct hernia has a more rounded shape than an oblique, and comes down at once into the scrotum.

An oblique is distinguished from a direct hernia by its neck being pyriform, extending more upwards and outwards along and above Poupart's ligament than in the direct form, and concealing the spermatic cord. In the direct form, the neck is globular; the finger traces the neck through the internal ring entering directly in the abdominal cavity above the pubic spine; the fulness is not traceable along the canal, but closely adjacent to the outer border of the rectus; the spermatic cord is placed externally as well as behind.

Diagnosis.—A bubonocoele has to be distinguished from, (*a*) *an abscess*, by the hernia exhibiting gurgling, greater solidity, and absence of fluctuation; from (*β*) *hydrocele of the cord*, by the latter occurring in very young children, its vibration, dulness on percussion, irreducibility, fluctuation, translucency, and it having no distinct expansile impulse; from (*γ*) *hæmatocoele of the cord*, which is accompanied by a soft, fluctuating swelling, ecchymosis of the integuments, is not completely reducible, and has no gurgling; from (*δ*) *undescended testicle*, which is known by the sickening pain on pressure, want of resonance, absence of gurgling and reducibility, and its not occupying its proper position in the scrotum; from (*ε*) *encysted tumours* of the inguinal canal, which are recognised by their irreducibility, want of direct impulse, globular form, mobility, and the situation of the cord above the cyst. From an *enlarged gland* the diagnosis is made by the glandular swelling being more superficial and freely movable than a hernia, not having an impulse, being irreducible, and generally a chain of glands will be affected.

Scrotal Hernia is distinguished from hydrocele by the latter proceeding from below upwards, being translucent, not disappearing on lying down, nor being changed in size or shape on pressure; having no impulse on coughing, no gurgling; the cord being clear and free above it, and the testicle above and behind. From varicocele a scrotal hernia is distinguished by directing the patient to lie down, reducing the swelling, firmly pressing on the external ring; on the

patient standing, if the tumour be a varicocele it will reappear in spite of the pressure, but if a hernia it will not descend. Varicocele feels to the finger like a bundle of worms, and has a bluish appearance.

A hernia is known from a tumour of the testicle by the latter being more or less solid, having no impulse on coughing, and by the inguinal canal being empty, and the cord easily to be made out.

From hæmatocele of the scrotum a hernia may be separated by the former being opaque, having a history of some injury, lacking an impulse, by its feel on palpation, the external ring being free, and the hæmatocele commencing from below upwards.

Treatment.—When reducible, apply a truss: for an oblique hernia the pad is to be placed over the internal ring and canal; for a direct hernia, the truss should press just above the external ring. To measure for a truss, take the circumference of the pelvis one inch below the crest of the ilium and the girth of the body, commencing and ending at the aperture of the hernia, also the distance of this aperture from the anterior iliac spine. If strangulated, an operation is necessary; the sac is exposed in the manner previously directed, the external ring is clearly defined, and the finger passed into it to ascertain if there be any constriction there. Should the ring be tight the internal pillar must be divided on the finger *directly upwards*, with a probe-pointed bistoury, and all constricting bands above the neck of the tumour raised on a director and cut. The canal and internal ring is then explored with the left forefinger. If the stricture be found at the internal ring outside the sac it must be cautiously nicked *directly upwards* with a hernia knife, and the hernia reduced. Should reduction be still impossible, the sac must be opened and slit up, the constriction sought for and divided *directly upwards*. The division must take place in this direction on account of the deep epigastric artery; in oblique hernia, this vessel is *inside* the neck, in direct hernia *outside*, but in old-standing cases it is difficult and often impossible, owing to the approximation of the rings, to ascertain what variety of hernia is present; so the best course to adopt in all cases is to cut directly up-

wards in a line parallel with the linea alba. The bowel must be then examined and treated on the principles already mentioned.

Congenital Hernia, or Hernia in the Tunica Vaginalis.—This hernia is called congenital because it does not merely come down at birth, but depends on a peculiar congenital state of the inguinal canal, which may persist throughout life. In the fœtus, the testicle descends from the abdomen along the inguinal canal; this descent is preceded by that of a piece of peritoneum (tubular vaginal process of peritoneum), which forms the tunica vaginalis, and is a prolonged portion of the serous lining of the abdomen. In the normal condition the bag containing the testicle is cut off from the general peritoneal cavity by obliteration at two points, the neck, and just above the epididymis, the passage through the inguinal canal between these two points being converted into a fibro-cellular cord, as far down as the head of the epididymis. Should the obliteration be delayed, and the tubular process remain open, the bowel escapes into the tunica vaginalis. The hernia usually occurs soon after birth, but may not appear until late in life, in cases where the testicle is late in descending; if the descent occur at birth, it is named "congenital;" when later in life, Birkett's Hernia into the Vaginal Process of Peritoneum, or Malgaigne's Hernia of Infancy. In many cases this hernia is associated with undescended testis, the latter occupying some part of the inguinal canal, or being situated in the abdomen. In other cases phimosis is conjoined. The neck of the sac is long and tubular, and the internal and external rings are never approximated, even in the adult. The testis is surrounded by the bowel, and cannot be distinctly made out. The rupture generally at once reaches the scrotum, and does not slowly make its way along the inguinal canal, as in the ordinary form. The sac is very often the seat of hour-glass contraction, owing to narrowing about the external ring. When strangulated, gangrene of the bowel is apt to ensue more quickly than in ordinary inguinal hernia, owing to the tight constriction of the narrow neck, so taxis should not be applied for any length of time. The stricture is generally seated in the neck of the tunica vaginalis, and this must

always be opened from the external to the internal abdominal ring. Hernia and omentum may be adherent to the testicle.

Treatment.—A truss should be constantly worn. Lund recommends for inguinal hernia in infants a worsted truss. A skein of Berlin wool tied together is applied round the pelvis and across the front of the abdomen. One end or loop of the worsted is placed directly over the outer abdominal ring, the hernia being reduced. The folded worsted is passed horizontally across the abdomen, just above the crest of the pubis, round the hip, behind the pelvis, and over the hip of the side of the hernia. The folded end is then passed through the loop of the skein, and will here form a knot or bulged portion, which is adjusted to the hernial opening; and being carried down the upper part of the thigh, between it and the scrotum, is brought round the external side of the thigh, near to the top of the great trochanter, and tied or fixed with a safety pin to the band encircling the pelvis. I have found this plan very successful, as it obviates the constant changes of truss otherwise necessitated by the growth of an infant. In older children a celluloid truss is very cleanly, as it can be washed. If the rupture, when occurring in a child, be prevented from descending, the prospects are very hopeful that a permanent cure will result, from obliteration of the vaginal process occurring. When strangulation is present, the sac is found to consist of the tunica vaginalis, and must always be opened, as the stricture occupies the inside of the neck.

Birkett's Hernia into the Funicular Portion of the Vaginal Process of Peritoneum.—In this form the process of peritoneum is open some way down the cord, but never as low as the testis, forming a pouch into which the hernia may descend, at birth, or later. The testicle lies below the hernial sac, but entirely separated from it. It develops frequently in infancy, often in youth and adult life. The hernia at once descends along the inguinal canal to the scrotum.

Encysted Hernia of the Tunica Vaginalis, or Acquired Congenital Hernia.—In this hernia the passage for the testicle has closed, but only at its neck, the sheath persisting from that point down-

wards to the testicle, where it expands, forming the tunica vaginalis, or as Hey succinctly describes, "the tunica vaginalis is continued up to the abdominal ring." A hernia protrudes the parietal peritoneum, forming its sac, into the tunica vaginalis, so that the hernia *with its sac* is contained in this cavity.

The treatment is similar to that for congenital hernia. If strangulated, on the tunica vaginalis being opened, the hernia will not be seen until the sac be laid open within the tunica vaginalis. The hernia has thus two coverings of peritoneum, one forming the sac, the other the tunica vaginalis.

Femoral Hernia is a hernia descending through the femoral or crural ring, between the vessels and the crescentic margin of the crural arch. This hernia is rare in males, but very common in the female, on account of the femoral ring being much larger in women, which is due to the fact that there is a greater space between the anterior superior spine of the ileum and the pubis. The rupture enters the femoral ring, a space bounded on the outer side by the fascia surrounding the femoral vein (the innermost division of the crural sheath), on the inside by Gimbernat's ligament and the margin of the conjoined tendon behind it, in front by Poupart's ligament and the horizontal ramus of the pubis covered by the pectineus and fascia lata. In the normal state the ring is filled by fat, loose cellular tissue (fascia propria), lymphatics, and a gland, which are pushed forward by the hernia; in an old hernia these form a constriction round its neck. The hernia then enters the femoral canal, which is from 1 inch to 1½ inches in length, and is covered in front by the falciform process of the fascia lata and the cribriform fascia, behind by the pectineal or pubic portion of the fascia lata, externally by the femoral vein and femoral sheath. The rupture then passes under the falciform process and out upon the thigh, through the saphenous opening, when it proceeds upwards and outwards parallel to Poupart's ligament, and may rise above this. This hernia is never congenital, and rarely occurs under twenty.

Coverings. — 1. Peritoneal sac. 2. Subserous cellular tissue or fascia propria. 3. Septum crurale or subperi-

toneal fascia, recognised by its greyish blue or greenish colour. 4. Femoral sheath. 5. Cribriform fascia. 6. Superficial fascia. 7. Skin.

Relations.—The femoral vein is external, and only separated by its sheath. The epigastric artery above and to its outer side. The spermatic cord in the male, and the round ligament in the female immediately above it, with the pubic branch of the epigastric: thus the only parts free from vessels are the inner and posterior sides. The obturator artery, when arising from the internal iliac, which is its usual origin, does not come near the sac at all. In a certain number of cases (1 in $3\frac{1}{2}$) it springs from the epigastric, and in very few (1 in 72) from the external iliae. Most commonly when it is given off by either of the two last it is placed close to the iliac vein, and consequently passes downwards to the pelvis at the iliac or outer side of the neck of the hernia, but occasionally it descends at the inner or pubic side, at the base of Gimbernat's ligament, and will be in danger of being cut during the operation, the ring in this case being encircled with vessels, except at its posterior part.

Symptoms.—The presence of a tumour with the characters of a hernia, situated in the groin to the inner side of the femoral vessels and external to the pubic spine. It is often of small size, and then can be only discovered by feeling in the situation it is thought to be. The symptoms of strangulation are particularly severe and rapid in progress, owing to the boundaries being very rigid. A peculiar form of hernia is met with in this region (Littre's hernia). In this variety only a portion of the circumference of the gut is involved in the hernial ring, and the lumen of the intestine is not entirely occluded. When strangulated the tumour is often so small as to be overlooked, and the condition generally manifests itself in small reducible hernia where no truss has been worn. Pain is severe and vomiting early, but the latter is not so apt to be feculent as in the common form; constipation is usually incomplete, and loose motions may occur throughout the case; operation should be promptly performed.

Diagnosis.—*From inguinal*, by the femoral hernia appearing external to

the pubic spine and having its neck below Poupart's ligament. In the male the pubic spine can be felt by invaginating the serotum, in the female by abducting the thigh so as to make tense the tendon of the adductor longus, which will guide to the process. In femoral hernia the inguinal canal is free. The other tumours which may be mistaken for a femoral hernia are enlarged glands, psoas abscess, varix of the saphena vein, and cystic or fatty growths.

From enlarged glands a hernia is distinguished by the former being devoid of impulse; irreducible, being harder, more movable, and isolated; not having a fixed neck; generally, a chain of glands exists together, and is connected with some source of irritation in the foot or leg which will lead to their recognition; the femoral artery is beneath and to the inner side of the bubo, but external to a hernia. What may embarrass the diagnosis is the co-existence of enlarged glands and hernia; in doubtful cases, where there are sickness, vomiting, and constipation, the surgeon must cut down on the tumour and examine its nature. The rule has been concisely stated, "When in intelligent doubt, skilfully operate."

In a psoas abscess fluctuation can be detected; it is not removable entirely by pressure whilst the patient is erect, and there is no gurgling. The history is different from that of a hernia; the thigh is often flexed, and a psoas abscess spreads further and further down the thigh. The abscess is usually *outside* the femoral vessels, and when inside it points lower down and more internal than the saphenous opening.

Varix of the Saphena Vein is distinguished by it being continuous with a varicose condition of that vein below the seat of a hernia; by its being reducible on the patient lying down, and filling up from below, in spite of pressure being made on the femoral canal when the patient assumes the erect position. The varix is softer than a hernia, has a knotty feeling, and the skin is often of a bluish or purple colour; the impulse is more thrilling and less distinct than in hernia.

From Cystic and Fatty Tumours a hernia is recognised by the former having a different form, no distinct impulse,

being irreducible, and differing in consistence.

Treatment.—When reducible apply the taxis, and adjust a truss. In the application of the taxis an anæsthetic should be used, the legs are to be bent and adducted to relax the fascia lata, the tumour must be pressed inwards and downwards, then backwards through the saphenous opening, and finally upwards.

Operation for strangulated hernia must never be delayed too long, as the parts producing the stricture are very rigid, and the bowel soon becomes gangrenous. Herniotomy should thus be performed immediately after the taxis, if this prove unsuccessful. The incision which is preferable is a linear one; but, if much space be required, a T-shaped wound may be used. The incision is made by pinching up a fold of skin transversely to the tumour, and transfixing it with the knife, care being taken so to slope the knife that the incision is placed on the inner side of the neck of the tumour. If a T-shaped incision be used, the horizontal branch is made just over Poupart's ligament, and parallel to it, with its centre corresponding to the neck of the sac; the vertical limb is made as previously directed, by transfixion. The flaps are dissected back, and any bleeding points tied with catgut or twisted. The underlying tissues must be divided, and the sac exposed in the usual manner. Then, if only the minor operation without opening the sac be required, the saphenous opening must be carefully exposed and divided on its upper and inner side, the finger passed along the femoral canal in front of the bowel to the neck of the sac, and Gimbernat's ligament nicked upwards and inwards to the extent of a line or two, the surgeon having felt for any pulsation before attempting to divide the stricture, and taking care that the knife be not introduced too deeply. The bowel should then be reduced, and the sac left outside. Gay advises "an incision, rather more than an inch long, to be made near the inner side of the neck of the tumour. The superficial fascia to be divided, and a director or bistouri caché introduced down to the neck of the tumour, and through the femoral ring, by the least amount of force, and with the aid of a little gentle compression of the inner side of the tumour by the finger, the point of

the bistoury may be insinuated between the sac and the pubic margin of the ring; the edge of the knife is then to be turned towards the pubes, and by projecting the blade the seat of stricture in that direction may be effectively divided." This method is worthy of trial in all cases where the taxis fails, as the incision can be used afterwards.

When it is necessary to open the sac this must be very carefully done, as there is usually little or no fluid in the sac. The sac is then slit up by a probe-pointed bistoury, guided by the finger. The forefinger is then introduced into the sac as high as possible, with the nail to the bowel, and any constriction cautiously divided in an *upward* and *inward* direction, to avoid the femoral vein, epigastric artery, and spermatic cord, or round ligament. If an artery be wounded an attempt must be made to twist it, or ligature it with catgut, dividing, if necessary, Poupart's ligament; if this be unsuccessful, pressure, either digital or by means of a compress and bandage, must be resorted to. The minor operation should only be performed when the hernia is recent, the constricting parts loose, the symptoms not very acute, and the bowel is believed to be healthy. It is generally found that the intestine of a femoral hernia is tightly nipped and much congested.

Umbilical Hernia, or Exomphalos, is the name given to the protrusion of omentum or intestine at the navel, and occurs either in children or adults.

Infantile Umbilical Hernia is occasionally a congenital affection, the hernia being present at birth, the bowel escaping through the umbilical ring, and the sac being formed by the coverings of the cord; it may be associated with other malformations. More commonly it occurs soon after birth, subsequent to the separation of the cord and cicatrization of the navel, from crying, straining, or coughing. The hernia forms a small, round, smooth tumour, which is easily reduced, but springs forward again suddenly when pressure is removed. On introducing the finger, after reduction, the opening is felt to be circular, with a well-defined margin.

Treatment.—An air pad with an india-rubber belt; or a pad, formed by lint wrapped round a penny piece, and a belt

of adhesive plaster to fix it. With a little attention these cases nearly always result in a cure, there being a great natural tendency to the contraction of the umbilical ring; so that, though common in children, this hernia is rare in young adults.

Umbilical Hernia in Adults generally occurs in women, especially those who have had a large family, are stout, and have passed middle life. It is of large size, has an impulse, on percussion part of it will yield a clear note, and a part or the whole can be reduced. The contents are almost always omentum, loaded with fat, thickened, and hardened. Colon is often contained in the sac, and rarely the stomach, duodenum, liver, gall-bladder, cæcum, sigmoid flexure, uterus, ovaries, and bladder. Gross writes: "In corpulent persons it often manifests a disposition to insinuate itself beneath the skin, within the adipose matter, and the consequence is that it hardly forms any perceptible enlargement. A hernia in such a state is peculiarly dangerous if it happen to become strangulated, from its liability to be overlooked, and, therefore, mismanaged." The mouth is often large in comparison with the size of the tumour, and generally situated in the linea alba close to the umbilical ring, but not actually at this situation; as the hernia increases in size the larger portion passes downwards towards the symphysis pubis.

Coverings are often very thin. 1. Peritoneum. 2. Superficial fascia. 3. Skin.

Treatment.—If reducible, a pad and belt; when irreducible, a belt or support. If it be incarcerated or painful, a condition very prone to occur, use the usual means and persevere for some hours. In performing the taxis the fundus should be placed in the hollow of the hand, and lifted up gently, while the fingers of the other hand manipulate the neck of the sac with a lifting pressure to clear the bowel of the tense lower edge of the hernial opening.

Operation must, if possible, be the minor one. The tumour is to be lifted up, and an incision made over the neck in the middle line, two or more inches in length. The incision should extend below the navel cicatrix to the lower border of the hernial opening, and must be cautiously made, as the coverings are so thin; the lower edge of the strangulating

ring should be well exposed. After dividing the skin and fat, the finger is passed under the ring through which the neck passes, and the stricture divided downwards on the middle line, and the hernia reduced. If the sac have to be opened this must be carefully done on a director, and before doing so a large sponge wet with warm carbolic lotion (1 to 40) should be placed on the abdomen on each side of the hernia to receive and enclose any bowel that protrudes. The sac is pinched up with the forceps, and opened with a scalpel held laterally. The fingers are introduced into the opening, the broad hernia director passed downwards, and the sac opened upon this in the middle line. The hernia is lifted up, and with the finger as a guide, the lower constricting edge of the opening cautiously divided with the hernia knife as far as needful. The omentum is examined, and if diseased, the vessels should be tied with fine catgut carried round them with a common sewing needle, and then the mass should be cut off with blunt scissors, and all bleeding points carefully tied. The edge of the omentum is arranged so as to meet the lower cut edge of the hernial opening (Wood). Sutures should pierce the whole abdominal wall, including the peritoneum, and be closely applied. A drainage tube at the lowest part of the wound. If small, the whole of the sac may be removed and a portion of the thin skin over it, and the wound may then be brought together with thick, silver wire sutures and leaden bullets, taking a good hold of the recti muscles and sheath, the skin being united by close points of silk suture, and the whole covered by a gauze dressing and a flannel bandage. If an artificial anus be unavoidable, the bowel is to be stitched to the skin to prevent extravasation, and the opening covered by carbolic lint and tow.

The other forms of hernia, ventral, sciatic through the sciatic notch, obturator through the thyroid foramen, perineal, vaginal, pudendal, lumbar, and diaphragmatic, are so rare that it is unnecessary to consider them here.

In some cases of hernia, when the patient objects to the annoyance of a truss, is likely to be in a situation where a truss could not be procured, or wishes to enter some employment in which a

rupture would be prohibitive, a radical cure may be attempted.

Operations for the Radical Cure of Hernia.—*Heaton's method* consists in injecting decoction of oak bark around the hernial ring: it is harmless, but very uncertain.

Wutzer's Operation is seldom performed, and but rarely successful. The principle of this operation is the invagination of a piece of scrotal skin into the inguinal canal and its retention there. The forefinger, carrying with it the skin of the scrotum, is passed into the inguinal canal as high as the internal ring. A hollow wooden cylinder well oiled is guided by the finger, which is gradually withdrawn as the instrument enters. When the end of the instrument is firmly lodged in the internal ring a long curved needle is pushed through the interior of the cylinder, and pierces the anterior wall of the canal, its point appearing outside the skin; a concave boxwood case is passed over the point of the needle and fixed at the other end by a screw, by which means the skin, fascia, and sac are compressed. The plug is kept in for seven days.

Spanton's Operation is a convenient modification of Wood's method, but can only be used for reducible herniæ. Instruments required: Narrow-bladed knife, dressing forceps, and a strephotome (an instrument shaped like a corkscrew, with a movable handle). The patient has an aperient and enema previous to the operation, and is anæsthetised; the operator, standing on the left side of the patient, makes an incision through the skin of the scrotum over the fundus of the sac $1\frac{1}{2}$ to 2 inches below the pubic spine, and large enough to admit the forefinger. The sac and fascial tissues are separated from the skin with the handle of the knife moved freely round the internal surface of the wound, until enough has been separated to allow of the invagination of the sac into the hernial canal by means of the left forefinger. With this finger the parts are examined, and whilst it is retained the strephotome, held in the right hand, is thrust through the skin of the groin opposite the outer pillar of the internal ring, and through this pillar until the point be in contact with the left forefinger. A turn is given to the screw and the point is made to pierce the invaginated sac, and pushed in through

the internal pillar (conjoined tendon) as high up as can be safely reached with the point of the instrument guarded by the finger. Another twist is made, causing the screw to pass through the invaginated tissues and across the pillars of the external ring as many times as the length of the canal and the nature of the case will permit. The left forefinger is gradually withdrawn as the point passes downwards and outwards through the opening in the scrotum, the spermatic cord lying behind, and slightly compressed by the gradual tightening of the hernial canal. The point of the screw is protected by a small india-rubber ball, and the handle lies flat on the outer surface of the abdomen. The scrotal wound is closed with a single wire suture, and a pad and bandage is applied over the whole. In from seven to ten days afterwards the strephotome is removed, and an oiled pad and bandage applied. If preferred an eyed strephotome may be used, the eye being at the point, and threaded with a ligature after the instrument appears at the scrotal wound, the ligature following the strephotome as it is withdrawn, and is then tightened by being fastened to a glass rod which lies on the groin; in ten to fourteen days the ends of the ligature are cut off. This method is the best for young patients and for moderately aged herniæ.

Open Operation consists in exposing the sac, tying its neck with a silver wire; excising the fundus, and stitching the abdominal rings with silver wire.

Wood's Operation by the Subcutaneous Method is founded on the principle of narrowing the canal by uniting its sides. This is a truly efficacious and scientific method of operating. The steps of the operation must be done subcutaneously, and care be taken to avoid injury to the bowel and spermatic cord.

The Operation.—The instruments required are a tenotomy knife with a cutting edge for one inch from the point, a stout back, and a handle thin, flat, and rounded, like a paper knife; a semi-circular needle mounted on a stout handle, flattened at the eye, with a sharp point and blunt shoulders, formed so as to slip along the front of the curved forefinger; a piece of kangaroo, deer, or ox tendon, well antisepticised in carbolic oil and softened before use by soaking in 1 in 40 carbolic solution; or a piece of

stout silvered copper wire one foot long. The patient lying on his back, his shoulders raised and knees bent, the pubes and scrotum are shaved, and an anæsthetic administered. The instruments and hands are washed in a 1 in 40 carbolic solution. The rupture is reduced, and the forefinger pushed well up the canal to clear the bowel out of it. An assistant now makes pressure over the internal ring, to prevent the rupture again descending. An incision is made with the tenotomy knife three-quarters of an inch in length, in an oblique direction over the cord, just below the pubic crest, and extending through the tegumentary coverings down to the sac. A small artery—the external pudic—may require section and ligature at both ends with fine catgut. The surgeon passes the forefinger, oiled, into the scrotal puncture, with the nail behind, and pushes it upwards in the canal, carrying the sac invaginated before it, as far as the deep ring, behind the internal oblique and transversalis muscles, which can be felt and seen to be lifted up by the forefinger. At the inner border, the edge of the deep ring or conjoined tendon can be clearly felt and the finger passed behind it. The curved needle unarmed is then passed along the finger until its point can be felt by the bulb of the finger placed behind the conjoined tendon, through which the needle is then pushed with its point directed inwards, and then through the aponeurosis of the external oblique until it raises the skin, which is drawn towards the middle line before being also penetrated by the needle at $1\frac{1}{2}$ inches external to the puncture through the deeper tissues. The tendon or wire is attached to the needle, which is withdrawn, bringing the tendon or wire with it, and the needle then detached. The finger is then passed behind Poupart's ligament, the spermatic cord felt for in its groove and pushed inwards; the point of the finger is placed in the groove which the cord occupied, and lifted forwards, so as to raise Poupart's ligament at its centre, and with it the outer portion of the superficial ring opposite to the deep ring; the needle is passed along the finger as before and made to pierce Poupart's ligament, the skin being drawn outwards until the point of the needle appears at its former puncture, through which it is then

pushed. The other end of the tendon or wire is passed through the eye of the needle, drawn down into the scrotum, and detached. Both ends of the tendon or wire now hang out through the scrotal incision, and its centre forms a loop upon the groin; one end has passed through the conjoined tendon and the internal pillar of the superficial ring; the other through Poupart's ligament and the external pillar of the same ring. Next the sac and its coverings are pinched up at the scrotal incision, between the finger and thumb, and separated from the spermatic cord, as in ligaturing varicose veins. The needle is carried across behind the sac and between it and the cord, entering at one corner of the scrotal puncture and emerging at the other; one of the ends of the tendon or wire (Mr. Wood prefers the inner one) is then attached to the needle and drawn back with it across between the cord and the sac. In a large case, especially if the rupture be a direct one, the needle is lastly to be passed through the end of Poupart's ligament, just above the pubic spine, and then carried through the inner pillar of the ring and the triangular fascia close to the os pubis, at the edge of the rectus muscle. The outer end of the ligature is then connected and drawn across, so as to lace up the canal like a boot. In the case of tendon ligature being used, it is now braced up tightly, tied in a well-secured surgeon's knot, cut off close, and buried in the wound. If wire be used, both ends are then drawn down until the loop projecting at the groin is one inch long. The ends of the wire are twisted together for three turns and cut off with pliers, leaving a length of three inches, which is bent into a hook. Traction is then made on the upper loop, until the sac and scrotal fascia be closely invaginated as high as the deep ring, when the loop is bent downwards and the hook formed by the ends of the wire bent upwards and hooked on to it. A stout pad of lint is passed under the loop of wire and a spica bandage applied. The wire is retained from a week to ten days, according to the size of the hernia. In wire cases, no drainage tube or antiseptic dressing is required; the wire acts as a straight and perfect down drain; the operation is subcutaneous, and the wound rarely even suppurates. When tendon is used, a drainage tube should be placed

reaching from the superficial ring into the scrotal puncture, and the gauze dressing applied in the usual way by a double spica bandage, with a piece of jacquenet, through which the penis is passed, placed over all to keep off urine from the absorbent dressing. If the scrotal opening be made larger in order to remove the sac, some stitches should be placed, pretty close together, above the drainage tube. In such a case the scrotal opening can be drawn up and stretched, so as to allow the needle to pass out and in through it instead of through separate groin punctures. Thus the whole operation can be done through a scrotal opening of the length of two inches. The patient should be placed in bed resting in a half sitting posture against a bed chair, with his knees drawn up over a bolster. An opium suppository should be used just after the operation. If the operation be properly executed it fulfils the following requirements for the permanent cure of inguinal hernia:—1. The deep ring and hernial openings are closed flush with the peritoneum, whilst the internal oblique and transversalis muscles, and the external oblique aponeurosis, are united to each other and to the deep hernial opening and mouth of the sac, so as to close, sustain, and support it against a fresh protrusion. 2. The conjoined tendon, forming the hinder or deep wall of the canal, is united to Poupart's ligament, close upon and over the spermatic cord and twisted sac. Thus the valve action of the canal wall is restored and the deep ring supported from below. The muscular and aponeurotic layers between which the canal lies are bound together by adhesions where they had been separated by the hernia. 3. The pillars of the superficial ring are laced up like a boot, supplementing the weakened arciform fascia, supporting the other adhesions, and forming a third line of defence against a renewal of the protrusion. There is no permanent invagination of fascia after the purposes of the operation itself are fulfilled. The firm mass of material which afterwards becomes apparent, is composed of fibrinous effusion, which contracts and hardens like any other cicatrix.

Causes of Failure.—1. Not placing the sutures close to the edges of the deep ring. 2. Not securing the conjoined tendon properly. 3. The pillars of the

superficial ring may not be closely and continuously united along their whole length. 4. Adhesions formed at the time may yield and give way.

Dangers to be avoided.—Puncture or wound of the bowel; by keeping the needle on the finger placed in the proper position this can be prevented. Wound of the femoral or iliac vessels; to escape this peril the finger should be kept in front of the vessels, and Poupart's ligament be lifted well up. Damage to cord. Atrophy of the testicle.

In congenital hernia and small ruptures in children and young boys, Wood uses rectangular pins instead of wire, and does not make a scrotal incision. The conjoined tendon and internal pillar being transfixed by the first pin passed through the skin of the groin from above downwards, and the outer pillar transfixed and included by the second pin passed from below upwards. During the application of the pins one of the fingers invaginates the scrotal fascia in the canal and protects the deep-seated parts. Each of the pins traverses the same punctures as the other, and the point of each passes through a loop situated at the angle of the pin. They are held in position by lint, pads, and strapping.

Hernia Complicated with Retained Testis.—This hernia is always congenital. Wood advises that the testicle should be freed, by an open incision, from its adhesions and abnormal attachments in the canal and rings. Adherent omentum removed when necessary, and the spermatic cord examined and cleared from adhesions. The cord is then carefully stretched by being pulled forwards and outwards, and then slipped down into the upper contracted part of the imperfect scrotum previously dilated by the introduction of the finger, and freely stretched like a glove until it be large enough to hold the testicle. A thick silk or tendon ligature is then passed through the hinder and lower part of the scrotum by means of an ordinary curved or handled needle, then it is made to pass through the fibrous tissues in close contact with the testicle and spermatic duct, and out again through the scrotum about one inch distant from the first puncture. The ends of the ligature are then tied over a carbolised pad of the size of the end of the thumb, at

the bottom and back part of the scrotum. If the spermatic cord be too short, carefully dissect with the point of the scalpel through the connective tissue, attaching the testicle to the globus major, so that the former can be turned upside downwards with the lower part of the epididymis and globus minor still attached to it. By this means the length of the testicle is gained, and it then lies upside down in the scrotum, the cord and epididymis being above it. A drainage tube through the bottom of the scrotum, and the use of the spray and gauze bandage, are necessary. If the canal be patulous when the testicle is transplanted, put tendon sutures to its sides and rings as in the subcutaneous operation. If the funicular process be long enough to be brought down into the scrotum, it is used to form the tunica vaginalis, by being separated from the neck of the sac, and stitched up with a glover's suture by means of fine catgut. The neck of the sac from this point to the deep ring is then detached, tied with a double ligature of tendon or catgut at the level of the deep ring, and removed altogether.

Radical Cure after Herniotomy for Strangulated Femoral Hernia (Wood).—The patient is anæsthetised and the parts relaxed by position. A vertical incision is made over the site of the hernial tumour by pinching up a fold of skin, transfixing, and cutting from within out; this will usually expose the cribriform fascia. In stout subjects it is better to cut from without inwards. The deeper tissues are then cut through and the sac exposed. This is opened by pinching up a portion, and lateralisation of the knife, and slit up vertically with or without the guidance of a director. With the handle of the knife the sac is then carefully separated from the surrounding structures, and its contents examined, all thickened and adherent omentum being removed, after ligature of the vessels separately with fine catgut. The sac, having been carefully emptied, is to be transfixed at its neck with the handled hernia needle, carrying a stout tendon ligature, tied on each side and cut off close. Next, the needle is carried through the deep layer of the femoral sheath and the pubic portion of the fascia lata, entering an inch below the femoral ring, and emerging close up

to the pectineal line at the side of the femoral vein, which is to be carefully protected with the finger or spatula. The needle is then carried through Poupart's ligament, emerging at the upper part of the incision. It is then threaded with one end of the same stout piece of tendon used to ligature the sac, and is then drawn down, emerging at the lower part of the incision. The needle is disengaged and passed again through the pubic portion of the fascia lata, skirting Gimbernat's ligament, and transfixing a second time the inner end of Poupart's ligament; the upper end of the tendon ligature is then threaded and withdrawn as before. The two ends are tied with a double surgeon's knot. Care must be taken to guard the femoral vein with the finger, and avoid injury to the bowel, spermatic cord, and epigastric artery, by not pushing the needle too far into the abdominal cavity. A drainage-tube or horsehair is placed along the wound from the ring to the lowest angle, the wound closed by closely applied interrupted sutures, and gauze or cotton wool dressing in the usual manner.

Radical Cure of Umbilical Hernia (Wood).—The instruments used are a needle, well curved near the point, a small spoon-shaped director, and one or two pieces of stout silver-coppered wire. The patient is anæsthetised, put on his back, knees flexed and shoulders raised, and the rupture is completely returned. The convex surface of the director, well oiled, is passed into the hernial opening, invaginating the skin well behind the edge of the tendinous aperture and at one side. The needle carrying one of the wires is then placed in the hollow of the director, and pushed through the tendon from behind forwards, well above the transverse diameter, the skin being drawn upwards so that it may be pierced at a lower level than the tendon. The wire being drawn through, the needle is freed, attached to the second wire, and passed in the same way through the tendon below the transverse diameter on the same side, and made to issue through the previous puncture in the skin by this being drawn downwards; the end of the wire being drawn through, and the needle unthreaded. The procedure is repeated on the other side, and the ends of the wires drawn on until the

middle portions have sunk through the punctures in the hernial walls. The ends are then to be twisted down into the side punctured, by two twists, and brought over so as to hook into the loop. If a common suture needle be used, two wires must be employed and both ends twisted, but with a special needle one wire will serve. The wire is thus drawn across the opening and through its borders at equal distances above and below

its centre, passing out at each side through the same punctures in the skin. When drawn tight, the wires disappear into the puncture first made in the middle line for the temporary purpose of their application. The ends of the wire are hooked over a roll of lint, the whole being retained by strips of strapping and a bandage with pads of lint at each side. The wires are kept in until they ulcerate, which occurs in a week or ten days.

CHAPTER XXXII.

INTESTINAL OBSTRUCTION.—COLOTOMY.—COLECTOMY.—LAPAROTOMY.—ENTEROTOMY.

Intestinal Obstruction is divided into acute and chronic.

Acute intestinal obstruction occurs when symptoms of complete obstruction develop themselves in a few hours in a previously healthy individual.

Causes.—1. Within the bowel: (α) The impaction of foreign bodies introduced from the exterior of the body, as coins, fruit stones, bullets, string, hair, dirt, oat cakes, pebbles, pins, fish bones, false teeth, etc. The impaction is most likely to occur in the vicinity of the cæcum. (β) The impaction of bodies formed within the body, as gall stones, hard fæces, etc. 2. In the walls of the bowel: congenital strictures or malformations, chiefly at the anus, very rarely in the duodenum. 3. External to the bowel: (α) Volvulus, twisting or rotation of the bowel, in which the bowel is twisted on its mesenteric axis, but occasionally on its own axis, with its attached mesentery, this being of unusual length, and thus permitting the rotation. The seat of the twist is always at the posterior wall of the abdomen, most often the sigmoid flexure is involved, and the exciting cause is distension of the bowel, generally by feculent matter, whilst the tightness of the twist is proportionate to the amount of distension. As a rare form one coil of bowel may become firmly intertwined with another. (β) Internal hernia: a piece of bowel slipping through a hole or pouch in the mesentery or omentum, or due to the formation of bands or adhesions from previous peritonitis (not uncommon in persons

with old herniæ), or adhesion of portions of the intestines to the abdominal walls or adjacent viscera, or more rarely from the passage of the gut into normal openings, as the foramen of Winslow. The small intestine is almost always the part affected. 4. Invagination, or Intussusception, the upper portion of bowel being prolapsed into that below it. This may be acute, and either affect the small intestine (enteric), or the ileum and ileo-cæcal opening may descend into the cæcum (ileo-cæcal), or even into the colon (ileo-colic). When implicating the colon (colic), it is usually chronic. It may result from the irritation of worms, or from polypus, or other irritation of the mucous membrane. The portion first prolapsed always remains the lowest, as the invagination increases at the expense of the bowel below the commencement of the part first prolapsed, except in the ileo-colic variety, which increases by more and more of the ileum passing through the ileo-cæcal valve; when no more ileum can protrude, then the cæcum becomes invaginated into the colon. A perpendicular incision through an intussusception shows three layers of intestinal wall lying parallel one with another. One layer consists of the portion of gut which receives the invagination and forms its sheath; the other two consist of the ensheathed portion of intestine, making a double fold; thus proceeding from the exterior there is: 1. Peritoneal coat; 2. Muscular; 3. Mucous; within this: 1. Mucous; 2. Muscular; 3. Peritoneal and mesentery

or meso-colon. Internally: 1. Peritoneal; 2. Muscular; 3. Mucous. "The invaginated portion does not lie parallel with the sheath, but always offers a greater curvature than the latter, the inverted tube being compressed on its concavity into tense folds. The orifice of the invaginated portion of the bowel does not lie in the axis or in the centre of the sheath, but towards the side, and following the traction exerted on it by the mesenteric fold of inverted intestine, it is directed towards the mesenteric wall of the sheath. The opening is not circular, but represents a fissure." (Rokitansky.)

Causes of Chronic Intestinal Obstruction.—1. Within the bowel: Habitual constipation and polypus. 2. In the walls of the bowel: (α) Cicatrisation of an ulcer, either simple or syphilitic; (β) Fibroid infiltration of the walls of the gut; (γ) Cancer; (δ) Spasm, or paralysis of the muscular coat. 3. External to the walls: (α) Chronic peritonitis, either simple or tubercular, and abscess; (β) Tumours pressing on the bowel, as hydatids, ovarian, or uterine tumours.

Sex and Age.—Obstruction from the impaction of gall stones occurs most commonly in women at the middle period of life, the average age being fifty to

sixty-five. From internal hernia, ileo-cæcal intussusception, and foreign bodies, obstruction is frequent in youth. As a consequence of volvulus, intestinal concretions, foreign bodies, intussusception of the ileum or jejunum, simple or syphilitic stricture, internal hernia, presence of tumours, peritonitis, habitual constipation, and cancer, obstruction is met with after puberty and in middle age. From cancer, thickened intestine, intussusception of the colon, and simple stricture in old age.

Symptoms of Acute Intestinal Obstruction.—1. Pain, sudden and severe, being often more intense at one spot. 2. Vomiting, becoming after a time fæcal. 3. Absolute constipation, appearing suddenly. 4. Abdomen immensely swollen and tender. 5. Collapse and fall of temperature. 6. Quick pulse, thirst, and loss of appetite. 7. On examination a localised swelling can sometimes be detected. 8. Hæmorrhage is sometimes present, from the rupture of distended vessels, the blood being vomited or discharged per anum. 9. The urine is often scanty or suppressed.

Treves, who has given great attention to this subject, gives the following excellent table.

TABLE I.—ACUTE OBSTRUCTION.

SYMPTOMS.	STRANGULATION BY BANDS, ETC., AND THROUGH APERTURES.	VOLVULUS OF THE SIGMOID FLEXURE.	ACUTE INTUSSUSCEPTION.	ACUTE OBSTRUCTION BY GALL STONES, ETC.
Sex. Age.	More common in males than females, mostly in young adults. Rare after 40.	Males to females as 4 to 1. Very rare before 40. Most common between 40 and 60.	A little more common in males; mostly in the young. One half of the cases are under the age of 10.	Gall stones are much more common in females than males. Average age 50 to 65.
Previous history.	History of previous peritonitis.	History of long-standing chronic constipation.	Nothing of note.	Gall stones may have been passed. History of hepatic colic. History of foreign bodies swallowed.
Mode of onset.	Sudden.	Sudden.	Sudden.	Sudden.
Pain.	Appears early, is very severe: is colicky and persistent; is often situated about umbilicus.	Appears early, is severe, but not so severe as in the previous case. Is intermittent at first, and then continuous with exacerbations.	Appears early, is severe at first, then tends to subside, is at first usually distinctly intermittent, then becomes continuous, with exacerbations. May be localised about a tumour.	Appears early, is severe and continuous, with exacerbations.

TABLE I.—ACUTE OBSTRUCTION (*continued*).

SYMPTOMS.	STRANGULATION BY BANDS, ETC., AND THROUGH APERTURES.	VOLVULUS OF THE SIGMOID FLEXURE.	ACUTE INTUSSUSCEPTION.	ACUTE OBSTRUCTION BY GALL STONES, ETC.
Vomiting.	Appears early, is constant, copious, and very severe. In 60 per cent. becomes stercoraceous on an average on the 5th day. It gives no relief.	Appears less early, and is less marked, and less severe, than in the previous case. Is intermittent at first, and then continuous, with exacerbations.	Does not appear so early as in the two previous cases. In 8 per cent. there is no vomiting; is often scanty; is liable to great fluctuations, in 25 per cent. the vomiting becomes feculent on an average on the 5th day.	Appears early, is often copious. May in time become stercoraceous.
Constipation.	Complete and absolute from the first. No discharge of blood from the anus.	Complete and absolute from the first. No discharge of blood from the anus.	Absolute constipation is extremely rare; diarrhoea is the rule. In 80 per cent. a bloody discharge from the anus.	Complete from the first. No discharge of blood from the anus.
Tenesmus.	Absent.	Met with in 15 per cent.	Met with in 55 per cent.; is often severe.	Absent.
Prostration.	Marked. There is collapse, intense thirst, diminished urine.	Not so marked as in the previous case. May be collapse and diminished urine. Often severe dyspnoea from distension of the abdomen.	Marked; often severe collapse in the young.	Marked, but seldom so pronounced as in the previous forms of obstruction.
Abdominal parietes.	Flaccid unless peritonitis has set in.	Soon become rigid owing to the early and almost constant appearance of local peritonitis.	Flaccid unless peritonitis have set in.	Flaccid unless peritonitis have set in.
Meteorism.	Slight. Seldom appears before the 3rd day.	Appears early, increases rapidly, and becomes very extreme. It often causes displacement of the thoracic viscera.	Is rare, and, indeed, absent except in cases associated with constipation.	Slight.
Abdominal tumour.	Tumours of limited areas of dulness, due to distended or strangled loops. Coils of intestine are not visible through the parietes.	No tumour. Coils of intestine are not visible.	A definite tumour in 50 per cent.; is usually in the line of the colon. Is apt to change its place, to increase in size and density during attacks of pain, and to be the seat of tenderness. Is not felt over the hepatic or splenic flexures of colon. A tumour may be felt in the rectum, or the invagination may protrude from the anus. Coils of intestine not visible.	Large gall stones and foreign bodies have in rare cases been felt through the parietes. Large enteroliths may form distinct and hard tumours.
Average duration before death.	Five days.	Six days.	Of ultra-acute cases 24 hours; of acute cases 2 to 7 days; of sub-acute 7 to 30 days.	Seven days.

Symptoms of Intussusception.—1. Pain, sudden and severe. 2. Constant desire and ineffectual efforts to relieve the bowels. 3. Discharge of bloody mucus. 4. Elongated, painful, movable tumour detected in the rectum by the touch and speculum, or felt through the abdominal parietes. 5. Vomiting may be present, but is not at all constant. 6. Collapse.

Result of Intussusception.—The blood vessels of the part of the gut which is ensheathed become distended, this being followed by inflammation. The mucous

membrane pours forth thick mucus, often mixed with blood. Adjacent peritoneal surfaces are covered with lymph and become adherent. The prolapsed part of the gut may be attacked by gangrene, and be discharged, leaving an annular stricture, but peritonitis or collapse frequently proves fatal before this event can occur.

Hilton Fagge gives the following table as a basis for the differential diagnosis between ileo-cæcal and enteric intussusception.

ILEO-CÆCAL INTUSSUSCEPTION.	INTUSSUSCEPTION OF SMALL INTESTINE.
1. Tumour felt in some part of the colon, finally descending into the left iliac fossa, and at a later period detected in the rectum, or even protruding at the anus.	1. Tumour (if present) situated to the right of the umbilicus, and smaller.
2. Tenesmus, straining, and voiding of bloody mucus; copious hæmorrhage occasionally occurs, especially in infants.	2. Discharge of large quantity of blood, some of which may be vomited.
3. Violent paroxysms of pain may occur months before the development of other symptoms, the patient being well in the intervals. The symptoms may, on the other hand, all occur rapidly at the first, and be followed by death within three or four days.	3. The gradual increase of symptoms occupies a period of eight or ten days, and there is a possibility that the affected part may be thrown off, and recovery ensue.

Symptoms of Chronic Intestinal Obstruction.—1. Constipation, often alternating with diarrhœa. 2. Difficulty in defæcation. 3. Discharge of pus, blood, or mucus. 4. Small, long, thin, or flattened motions. 5. Colicky pains. 6. Nausea, eructations, vomiting, and other digestive

disturbances. 7. Tympanitic distension of the abdomen. The symptoms do not come on suddenly, but have been present for some time. Death occurs from exhaustion, peritonitis, rupture of the cæcum, or perforation of the sigmoid flexure.

TABLE II.—CHRONIC OBSTRUCTION (TREVES).

SYMPTOMS.	STRICTURE AND STENOSIS OF THE SMALL INTESTINE.	STRICTURE AND STENOSIS OF THE LARGE INTESTINE.	FÆCAL ACCUMULATION.	CHRONIC INTUSSUSCEPTION.
Sex. Age.	Non-cancerous strictures occur about early middle life. Cancerous strictures are very rare before forty. Unaffected by sex.	The same.	More often in females than males. In adults often in lunatics, hypochondriacs, &c.	More often in males than females, and most common during active adult life.
Previous history.	In non-cancerous cases there may be a history of dysentery, tuberculosis, injury, hernia, &c.	The same.	History of long-continued and increasing constipation, with declining appetite, foul tongue, occasionally nausea, feeling of languor and depression.	In 35 per cent. of the cases begins suddenly and becomes after a while chronic. In other cases the commencement may be very insidious.

SYMPTOMS.	STRICTURE AND STENOSIS OF THE SMALL INTESTINE.	STRICTURE AND STENOSIS OF THE LARGE INTESTINE.	FÆCAL ACCUMULATION.	CHRONIC INTUSSUSCEPTION.
Course.	Very irregular. Acute attacks may appear from time to time, and one such attack may prove fatal. Symptoms often subside or disappear for a while.	The same.	The abdomen becomes greatly distended, and the symptoms develop slowly and progressively.	Remarkable by its irregularity and fluctuation.
Pains.	Intermittent at first, with long intervals of freedom from pain. In time the intervals become shorter, and the attacks of pain longer. Attacks become more frequent and severe. Pain is usually increased by food, especially by indigestible food. When the obstruction is complete the pain is continuous, with exacerbations.	General character of the pain the same, but less severe. Is, as a rule, not affected, or but indistinctly affected, by food.	Pain develops gradually. Is at first paroxysmal, then continuous, with exacerbations. At any time evidence of acute obstruction may occur.	Distinctly intermittent. Is of irregular appearance and intensity. Is seldom severe; is often quite insignificant.
Vomiting.	Nausea during the earlier attacks of pain. Vomiting during the later and severer attacks. Is often provoked by food. In any case appears late. Is scanty and very rarely feculent, except towards the end of an acute obstructive attack.	General character the same. Appears later; is scantier; is not provoked by food; is never feculent except after many days of absolute obstruction; may be entirely absent.	Appears late; is scanty and irregular in its occurrence, is only feculent after a considerable interval of entire obstruction.	Is marked in only 50 per cent. Is of irregular occurrence; is most often associated with attacks of pain; may be induced or made worse by food. Feculent in 7 per cent. May be entirely absent.
State of bowels. Tenesmus.	Constipation in 60 per cent. Constipation with diarrhœa in 40 per cent. Constipation absolute during acute attacks. No blood passed per anum. No tenesmus.	Constipation the rule. In cancer, diarrhœa with constipation is common. In cancer, blood per anum in 50 per cent. Tenesmus especially increases with diarrhœa.	Pronounced and increasing constipation. No blood per anum. No tenesmus.	State of bowel varies greatly; irregular, and sometimes a tendency to constipation, and more often to diarrhœa. Blood per anum in 50 per cent. cases. Tenesmus in 13 per cent.
Meteorism.	Absent, except during obstructive attacks, or with absolute constipation.	Often very pronounced, especially when constipation lasts.	Is gradual, progressive, and often considerable.	Absent except during attacks of complete obstruction.
Tumour.	In non-malignant cases no tumour. In cancer a tumour in 30 per cent. of the cases. Coils of intestine in movement visible through the parietes.	In non-malignant cases no tumour. In cancer a tumour in 40 per cent. of the cases. Coils of intestine in movement visible through the parietes.	Tumour very usual. Is most often in the cæcum or sigmoid flexure. Is firm, may be doughy; is often nodular, may be very large.	Invagination tumour in 50 per cent.; mass felt in rectum in 30 per cent.
General condition.	Patient emaciates, especially in cancer cases. Is worn out by pain and digestive disturbances. May be collapsed during acute attacks.	The same.	Suffers seriously from the occasional obstructive attacks. General condition the same.	The same, often dies of marasmus.
Duration.	Three to five months, or longer.	Five to six months, or longer.	Many months.	One to six months, or longer.

Diagnosis.—The history must always be noted when possible, and the exact order in which the symptoms occurred.

1. Enquire as to the diet, uterine displacements, previous peritonitis, ulceration, gall stones, foreign bodies, etc.
2. Look for any constitutional cachexia, as cancer or tubercle.

If there be no tenderness of the abdomen, or pyrexia, the cause may be accumulation of faecal matter, stricture, either simple or malignant, tumours or an abscess compressing the bowel, or polypus.

When due to the Impaction of Gall Stones.—The symptoms are sudden, and acute enteritis is apt to arise. The pain is spasmodic, and relieved by pressure; jaundice is often present, and bile in the urine. There may be a history of previous pain in the right hypochondriac region, and vomiting, followed by jaundice. Occasionally pneumonia at the base of the right lung presents itself, and may mask the symptoms.

Acute Forms of Intussusception are easily diagnosed by attending to the symptoms, and perhaps the end of the prolapsed bowel may be felt or seen through the rectum. Constipation is rare, diarrhoea and a bloody discharge from the anus being almost constant symptoms. The abdominal walls are usually relaxed, and there is not usually much tympanites.

The Chronic Forms of Intussusception are apt to be confounded with perityphlitis. In the latter case there is pain and swelling on the right side of the belly for a considerable time before vomiting appears. There may be a doughy or brawny infiltration of the integuments, and often diarrhoea, and pain and flexion of the right thigh.

In Internal Hernia the symptoms are very urgent from the first. The pain is sudden, very severe, and continuous; not unfrequently follows some violent exertion. Vomiting comes on early, is incessant and copious. Peritonitis and enteritis, followed by gangrene, soon occur.

In Volvulus, in addition to signs of internal strangulation, the abdomen is often distended at first on one side and flat on the other.

In Chronic Stricture, suddenly obstructed, the previous long-continued difficulty in defæcation will point to the nature of the case. In cases of stricture

of the left side of the large intestine, the fecal accumulation is often greater in the cæcum than in the tract of bowel between this part and the stricture; consequently ulceration of cæcum may be present. When the obstruction is at the upper part of the intestinal canal, the vomiting is severe, and comes on early; if it remain bilious, the obstruction is very close to origin of the small intestines. The abdomen is not much distended, the urine scanty or suppressed. If water be injected, a considerable quantity can be retained. Gripping, colicky, irregular and incomplete intestinal evacuations, and the motions are healthy, and do not cause pain. If the large intestine be affected, the vomiting appears later, and the ejected matter becomes stercoraceous. The abdomen is very distended, and the shape and movements of the bowels can be detected through the abdominal walls. Little pain, constipation alternating with diarrhoea, motions are painful, and pus, mucus, or blood may be present. If the stricture be low down, as in the upper part of the sigmoid flexure, the bowel will not hold more than a pint and a half of water, injected through the rectum. In all cases the abdomen must be examined at the usual and unusual sites for hernia, and the rectum and colon, by the finger, hand, and long tube; the surgeon giving an anæsthetic if necessary.

Treatment.—In chronic cases, give rest to the part by confining the patient to a fluid diet, *no solids being allowed*. The surgeon should inject a cupful, or more, of olive oil, and administer copious enemata. All faecal masses must be cleared away, if necessary, by an iron spoon, or lithotomy scoop. If the obstruction depend on stricture situated in the rectum, this may be cautiously divided or dilated with the finger or rectal bougies, or a gum elastic catheter may be passed through the constriction, and warm water be injected. Should these measures not afford relief, and vomiting persist, as in chronic cases the obstruction is generally seated at the lower part of the bowel, it will be advisable to perform colotomy. The indications for this operation are long-continued and unyielding constipation, vomiting and tympanites. The question arises, on which side should the colon be opened? On the left side, if the rectum or sigmoid flexure be implicated, unless

there be tenderness and distension of the cæcum (cæcitis or typhlitis), in which case an early incision should be made on the right side, in the vicinity of the cæcum. The operation should also be performed on the right side in cases where the seat of obstruction cannot be determined. In chronic cases of obstruction occurring in the small intestines, as the result of peritonitis and matting together of the bowels, give oily laxatives, and if the obstruction continue, perform "enterotomy," in the right or left iliac fossa. For tympanites, turpentine enemata, and puncture of the gut with a fine tubular needle, aspirator, or trocar, are the most useful methods.

In Acute Cases.—Give opium (gr. ij) and belladonna (gr. ss) by the mouth, and if peritonitis be present, a small quantity of calomel (gr. ss to gr. j). If vomiting be obstinate, a solution of atropo-morphia may be administered subcutaneously. Warm fomentations and leeches to the abdomen may be tried, if the condition be not very urgent. The bowel must be cleared by an injection, and afterwards nutritious and stimulating enemata should be administered. Ice may be freely sucked. If relief be not afforded within two days, or as soon as possible if internal strangulation be diagnosed, or vomiting persist or become stercoraceous, laparotomy or abdominal section must be performed. In cases of volvulus of the sigmoid flexure, left lumbar colotomy is the operation of election. In cases of obstruction from the impaction of foreign bodies, abdominal section is to be performed, and if necessary, the bowel opened (enterotomy); in the latter case an artificial anus can be made, or preferably, the gut may be sutured.

In Intussusception, if chronic, the injection of a large amount of water or air may be tried before the third day, together with kneading of the abdomen, with the pelvis well raised. If acute, laparotomy is required, and in cases where the gut cannot be relieved, owing to adhesions, or swelling of the parts, resection of the affected portions of the bowel, and suture of the cut ends of the intestine. When the large intestine is the seat of intussusception, an artificial anus may be formed.

Colotomy.—(a) Amussat's Operation, or Lumbar Colotomy.—Instruments re-

quired: 1. Scalpel; 2. Probe-pointed bistoury; 3. Director; 4. Dissecting forceps; 5. Sponges; 6. Silver and silk sutures; 7. Artery and torsion forceps; 8. Retractors; 9. Fine ligatures; 10. Large trocar; 11. Tow; 12. Syringe with warm water; 13. Anæsthetic and inhaler; 14. Basins. The operation consists in making an artificial anus in the colon above the seat of obstruction; it is performed in cases of chronic intestinal obstruction, volvulus of the sigmoid flexure, cancer of the rectum, and imperforate rectum. One-third of the colon at its posterior aspect is uncovered by peritoneum, and here the bowel is to be opened.

Line of Incision.—To ascertain the proper place for the incision the centre of a line drawn from the anterior to the posterior spinous process of the ileum is first ascertained, and starting half an inch behind this a vertical line is drawn up to the last rib. The middle point of this line is exactly measured, and is the spot where the incision is to be made; it should be marked with ink on the patient. An anæsthetic is administered, and the patient placed in the semi-prone position, with a pillow under the left loin.—(1st Step.) An incision is made four inches long in a transverse direction, its centre occupying the middle of the vertical line before mentioned; this divides the skin and superficial tissues.—(2nd Step.) The muscles of the abdominal wall, the latissimus dorsi at the posterior third of the incision, the external oblique in the anterior two-thirds, and the internal oblique and posterior aponeurosis of the transversalis are divided to the full extent of the external incision, constant use being made of the grooved director.—(3rd Step.) The quadratus lumborum and fascia transversalis are then recognised. The edge of the quadratus is one inch outside the erector spinæ, and three inches from the lumbar spinous processes. The fascia is now carefully divided, and the adipose tissue covering the intestine should appear in the wound, but if it do not, the quadratus lumborum must be divided towards the spine, as the gut is always found in the angle of the wound nearest the spine. The fat must be divided with the finger or handle of the scalpel, when the colon will be seen in front of the lower border of the kidney and recognised by its greenish colour,

distension, and by its not moving with the respiratory efforts. If the gut do not appear the patient may be turned on his back, and whatever falls in the wound seized with the forceps, and in most cases this is the colon.—(4th Step.) Two long silk sutures with a needle at each end are passed through the gut transversely, parallel with the edges of the wound. The four needles are passed through the skin, two at the upper and two at the lower side of the wound.—(5th Step.) The wound is filled with lint and sponges. Then the bowel is opened between the two sutures, the finger introduced, and the loops divided and rapidly tied. Usually a great gush of feculent matter occurs, which is to be received in basins; to avoid extravasation of fæces it is often advisable to tap the bowel with a large trocar before making the permanent incision. The sponges and lint are drawn out and the extremities of the skin wound stitched up. Where there is no great urgency the bowel should not be opened for a day or two after the operation.

After-treatment.—Lint saturated with carbolised oil and a pad of oakum should form the dressing. Prevent exhaustion and give opium. The escape of fæces can be prevented by an ivory or glass plug, and later on by a sponge tent. It is well when the bowel has contracted firm adhesion to pass a tube into the lower end and wash out any fæces. Madelung recommends that the lower end should be entirely closed.

Bryant advises an oblique incision, passing downwards and outwards at an angle of 45° , corresponding to the outer border of the quadratus lumborum.

(b) *Littre's Colotomy in the Groin.*—In infants, lumbar colotomy is difficult and uncertain; therefore the colon should be opened in the groin. An incision is made from one to two inches in length, parallel to and a little above the outer half of Poupart's ligament. The tissues being divided on a director, the peritoneum is reached and opened. The sigmoid flexure, recognised by its lobulated surface and fixedness, is sought, pierced by needles, and tied to the wound as in the previous operation.

Bryant's Lumbar Colectomy.—Bryant recommends this operation in stricture of the large intestine when annular, localised, and movable. The operation

consists in removal of a portion of the colon. He writes: "I commenced the operation with my usual oblique lumbar incision as for colotomy, and having reached the bowel, and found that the strictured portion could be drawn out of the wound, I determined to excise it. This I did by first stitching the presenting wall of the intestine above the strictured portion to the margin of the wound, evacuated the contents of the bowel through a limited orifice, and subsequently securing the under lip of the upper portion of the bowel to the lower margin of the wound; having with scissors carefully detached the strictured segment of the colon from its upper attachments, and stitched the bowel to the orifice of the wound step by step. The strictured segment of the gut was then separated from its attachments below, and the upper orifice of the lower portion of the bowel carefully secured to the wound in close contact with the upper portion."

Laparotomy, or Abdominal Section, is used for removal of foreign bodies, in acute obstruction, and in cases of intussusception, also in cases of injury to the abdominal viscera. The operation is simple. The room being well warmed, a catheter is passed and the patient's bladder emptied. He is then placed on his back, and brought to the edge of the bed with his legs hanging over it, and an anæsthetic is administered to him. Strict aseptic precautions must be used throughout. The incision begins an inch below the umbilicus (unless the seat of obstruction can be determined), it is carried down to the peritoneum. This is scraped through carefully at one spot, through which the finger is passed and the membrane slit up with a probe-pointed bistoury. The bowels must be kept back by an assistant with flat sponges wrung out of warm carbolised water. The condition of the cæcum is first ascertained; if this be empty the obstruction is in the small intestine. The seat of constriction is then sought for by tracing upwards the empty coils of the intestine; any displacement is then to be rectified. The intestines are now replaced, the peritoneum cleansed with aseptic sponges, and the wound closed in the usual manner. The after-treatment is that of an abdominal wound.

Enterotomy.—An incision is made one inch in length (afterwards increased to three or four), a little above the crest of the ilium, parallel with Poupart's ligament. The parts are divided layer by layer until the deep aponeurosis is reached; this is then cut through, and the peritoneum seized by forceps and incised. A silver thread is carried through that portion of the bowel which presents in the wound, penetrating first through the intestine and then through the abdominal wall. Stitches are then carried through the abdominal parietes, the gut, and then

again through the abdominal wall on the opposite side; two are passed on each side of the incision, and one at the superior and one at the inferior angles. A small incision is then made into the bowel, but if this can be postponed for a day or so it is advisable. Trousseau recommends this operation in all cases of intestinal obstruction, "when symptoms of occlusion have existed for six or eight days, when there is great tympanites, when the matters vomited are of a stercoraceous character, when the persistence and severity of the symptoms presage imminent death."

CHAPTER XXXIII.

DISEASES OF THE LARGE INTESTINE AND ANUS.

Imperforate Anus is a congenital defect. The anus may be completely closed by a membrane, or narrowed, contracted, and partially closed, admitting a probe but not affording a free exit to the fæces. The symptoms of complete closure are those of intestinal obstruction, namely, vomiting, swelling, and distension of the abdomen, and absence of the discharge of meconium. Examination of the part will reveal the membranous or mucocutaneous partition, which bulges when the child cries or on pressure of the abdomen, and through which the dark-coloured meconium may be visible.

Treatment.—In cases of partial closure the anus must be enlarged with a probe-pointed bistoury, a sponge tent put in, and afterwards the part kept dilated with a bougie. When the closure is complete the membrane should be punctured and then divided in a crucial manner, the four flaps removed, the skin and mucous membrane united by a few points of catgut suture, a plug of lint introduced, and the finger or a bougie oiled passed in twice a day.

Complete or Partial Absence of Rectum.—When there is no bulging after waiting for a day, the rectum is probably completely or partially absent, the intestinal canal terminating in a cul-de-sac, which is often situated at the sigmoid flexure.

Treatment.—Here an exploratory operation is to be done, with the aim of reaching the rectum and bringing it

down to sew to the margin of the anus. The child is anaesthetised, placed on its back, and its thighs held up. An incision is then made about one inch in length, in the middle line, extending forward from the tip of the coccyx. The parts are carefully dissected along the front of the coccyx and sacrum, and if the gut be near, it will be felt as a bulging, fluctuating tumour on pressure being made on the abdomen. If possible the gut must be brought down by hooked forceps; or, better, two sutures should be passed through one margin of the skin wound, across the bowel, and through the other margin of the wound; the bowel is then incised, and the loops of suture drawn down and divided, the gut being then fastened by the four sutures to the skin. If the bowel cannot be moved the passage to it must be kept open by passing a bougie or dressing forceps daily. Should the bowel not be found by a perineal incision Verneuil advises resection of the coccyx, the incision being carried back to the tip of the coccyx, the soft parts detached from this bone, which is cut across with curved scissors; the bowel can then often be discovered. In case these measures fail, the incision having been carried to a depth of one and a half inches without meeting the bowel, the surgeon must desist, and Littre's colotomy in the groin must be at once performed, as the rectum will be entirely absent.

Imperforate Anus, accompanied with

Vaginal, Vesical, or Urethral Fistule, is treated by passing a strong probe or director along the fistula, and projecting it towards the perineum; making an exploratory perineal incision as before mentioned, and bringing the rectum down and attaching it by sutures if possible to the sides of the anus, and afterwards, if the fistula do not close, performing a plastic operation.

Imperforate Rectum.—In this case the anus is natural, but a short distance above it an obstruction exists in the rectum. The obstruction may be simply a membranous partition, the rectum being pervious above it; or the rectum may have been converted into a fibro-cellular cord; or, thirdly, the rectum may terminate in a cul-de-sac, at the side of an anal cul-de-sac.

Treatment.—If the rectum be pervious above, on introducing the finger a bulging is felt, and a grooved needle should be passed through the membrane to confirm the diagnosis. Should meconium be present the membrane is incised crucially with a knife and a large catheter fixed in the gut. If no bulging be detected, the bowel must be sought for by introducing a probe-pointed bistoury in the anal cul-de-sac, and cutting down on the tip of the coccyx, carrying the dissection on as before directed. The bowel not being recognised, colotomy is the only resource.

Hæmorrhoids, or Piles, are divided, according to their relations to the sphincter ani, into: 1. External; 2. Internal; 3. Intero-external, partly within and partly without. Piles are also classed into "open" or bleeding, and "blind," which do not bleed.

Stricture.—Piles consist of dilated vessels surrounded by thickened cellular tissue, skin, and mucous membrane. In external piles the thickening of the skin and cellular tissue surrounding the vein is more marked; whilst in internal piles this thickening is not so advanced, and the tumours are much more vascular, usually containing, in addition to the veins, an artery.

Causes.—Age: In children piles are almost unknown. Young men from eighteen to twenty are subject to them, and there is a great liability to this complaint in middle age. Sex: They are more common in young men than women, owing to menstruation in the

latter; at the middle period of life both sexes are equally attacked. Habits: Luxurious and sedentary lives. Long standing, as in hairdressers and dentists. *Anything preventing the return of blood from the rectum, or determining a flow of blood to it*, as congestion of the liver, habitual constipation, pregnancy, pressure of ovarian tumours, uterine affections, thoracic disease, hard riding, habitual use of strong purgatives, intemperance in eating or drinking, exposure to cold and wet, immoderate sexual intercourse, diseases of adjacent parts, as the genito-urinary organs, fissure, ulcer, or stricture of the anus and rectum.

External Piles.—*Symptoms*.—These, which are situated external to the margin of the anus, are covered by skin; but when enlarged, may be partly enwrapped in mucous membrane. At first they present the appearance of loose, wrinkled, longitudinal folds, radiating from the anus, but finally form small, round, firm, rose-red tumours, varying in size from a pea to a walnut, according to whether they be distended with blood or not. They produce symptoms of irritation, weight, distension, and throbbing, pain when at the closet, and a feeling of bearing down. External piles are very liable to become irritated and inflamed, appearing as globular, tense, hot, livid swellings, attended with severe pain up the side of the rectum, in the perineum and nates, increased on standing or walking. Under treatment the inflammation may be checked and the swelling subside, but in many cases suppuration occurs, a small abscess forming; if the latter be opened, or burst, a small coagula escapes, and the cavity contracts, a radical cure taking place.

Treatment.—When not inflamed.—1. General: Attend to the regular action of the bowels. A glass of cold or warm water before breakfast, brown bread, regular exercise, are valuable auxiliaries. As aperients, pil. rhei. co.; confection of senna; compound liquorice powder; sulphur; extract. casc. sagrad. liq.; sulphate of soda; Hunyadi Janos or Friederichshall waters. The confection of senna with sulphur and bitartrate of potass is a favourite remedy. When there is a relaxed condition of the rectum and anus, the confection of senna should be combined with black pepper or

cubebæ. If there be much irritation about the anus, occasional doses of calomel are useful. No stimulants should be permitted, and the amount of animal food must be regulated. In debilitated persons, tartrate of iron, the mineral acids, and a nourishing diet. 2. Local: Bathing the parts with cold or very hot water night and morning. Lotions of lead, or sulphate of zinc (gr. ij to ʒj) are of service. The ung. gallæ. co. or gall and opium suppositories are excellent remedies. If inflammation occur, absolute rest in bed, leeches round the tumours but not on them, poultices of bran, linseed, or bread, with laudanum. Nothing is more soothing than equal parts of extracts of belladonna and opium smeared over the painful locality. Opium may be given internally, followed, when relief is obtained, by saline purgatives. When the inflammation has subsided, a lotion of sp. vini rect. and liq. ammon. acetatis āā ʒj to liq. plumbi acetatis dil. ʒvj should be applied. When the pile forms a circumscribed swelling of a blue colour as large as the end of the thumb, and covered with thickened skin, it must be punctured with a lancet, and its contents, consisting of coagulated or fluid blood, evacuated. If chronic, the pile is easily removed by seizing its apex with hooked forceps, and cutting it off close to its base with curved scissors, any vessel which jets being secured. Care must be taken not to remove too much loose skin or interfere with the mucous membrane.

Internal Piles—Symptoms.—1. Hæmorrhage, often profuse, occurring from time to time, and more especially after a motion. 2. Fulness and weight at the seat. 3. Pain when the bowels are moved. 4. A sensation as if there were a foreign body in the rectum. 5. Protrusion of the hæmorrhoids during straining at stool, the contraction of the sphincter ani on these causing severe sickening pain. 6. Pain in the loins and down the thighs, especially in females. 7. Discharge of mucus or muco-purulent fluid from the anus. 8. Irritation about the bladder, and there may be retention of urine. 9. In females, irritation of the uterus.

If the piles become inflamed the severity of the symptoms is augmented, and the tumours may protrude beyond the anus, and be tightly nipped

by the sphincter; great pain and fever follow, and unless bleeding occur, or the piles be returned, they become gangrenous and slough off. If the piles have existed for some time, the patient becomes very anæmic and debilitated from loss of blood.

Appearances of Internal Piles.—In most cases distinct tumours are visible, on examination, of a globular or oblong form. The globular are of a bright red colour, with a broad base, covered with smooth and shining mucous membrane, or slightly ulcerated, consisting mainly of small arteries and dilated capillaries, readily bleeding, and presenting a strawberry appearance (strawberry piles). The oblong or fleshy pile is large, prominent, of a deep blue or livid tint, having a broad base, or being pedunculated, less prone to bleed, and consisting mainly of dilated veins. In addition to these, cases are met with where there is no distinct tumour, but the mucous membrane of the lower part of the rectum is highly congested and vascular, and readily pours forth bright arterial blood (capillary hæmorrhoids). There may be two or three rows of piles placed one above the other at a distance of a few lines to $2\frac{1}{2}$ inches from the anus.

Complications.—1. Fissure of the anus. 2. Fistula. 3. Prolapsus.

Terminations.—1. Resolution. 2. Coagulation of the contents. 3. Suppuration. 4. Sloughing.

Treatment.—The general management of these cases is similar to that of external piles. I have found considerable benefit follow the internal use of tr. hamamelis combined with ergot and bromide of potassium. Gross recommends bals. copaibæ.—Local: Injections of cold water, or ext. ergot. liquid. (ʒss to ʒj), or infusion of quassia, are highly beneficial. Ergotin and gall and opium suppositories are advantageous.

When the piles protrude they must be bathed with infusion of quassia, decoction of oak bark, or alum. The application of nitrate of silver over the surface of the pile is advisable, or the ung. gallæ co. may be smeared over them. The return of the hæmorrhoids past the sphincter should be always achieved if possible. Hot hip-baths will alleviate the pain. Tho bleeding in florid sanguine persons need not be checked unless

excessivo, as it frequently is productive of good in relieving the portal system and preventing an attack of cerebral extravasation; but in pallid, anæmic individuals it must be stopped by injections of tannin (gr. viij to 3j), sulphate of iron (gr. ij to 3j), or turpentine, aided by perchloride of iron and glycerine by the mouth, or tr. hamamelis. Opium should be given in all cases where the bleeding is copious, and is best combined with tr. digitalis and liq. ammon. acetatis. Retention of urine must be relieved by the catheter. When the piles are protruding and inflamed they should be returned, an anæsthetic being administered if necessary. If this be impossible, leeches and poultices may be applied, or sponges wrung out of hot water. In some cases ice is preferable, to relieve pain and congestion. Opium must be given in full doses. When gangrene is present, apply charcoal poultices or iodoform and linseed, but do not return the piles.

Operations for the Radical Cure.—1. Ligature. 2. Cautery. 3. Nitric acid. 4. Crushing. 5. Injections. 6. Forceible dilatation of the sphincter. 7. Ignipuncture. 8. Excision. No operation should be performed for piles when these are the result of some disease situated higher up the bowel, as stricture or cancer; or when following diseases of the womb, bladder, cirrhosis of the liver, or thoracic disease; nor when occurring during pregnancy, unless dangerous hæmorrhage ensue. Before operating always ascertain if the kidneys be healthy.

1. *Ligature* is the oldest method, and is performed as follows. The bowels must be well cleared by a dose of castor oil the day previous to the operation. The patient, who has previously had an enema of warm water, is directed to sit over hot water and strain till the piles are well protruded. He is then placed in bed on his side, with the buttocks well projecting, an anæsthetic administered, an assistant separates the nates, and the surgeon seizes a pile with a vulsellum or ring forceps and draws it forward. Cripps, after the patient is anæsthetised, first dilates the sphincter by passing the forefinger of each hand into the bowel, and exercising firm and continuous traction until the resistance of the sphincter be felt to give way.

He prefers the patient in the lithotomy position. The operator then, with a well-curved needle set in a handle and carrying a double ligature, transfixes the base, divides the threads, removes the needle, and ties each half as tightly as possible. Every pile more than half an inch in diameter must be thus transfixed and tied; if smaller than this, a single ligature may be used, and transfixion is not necessary. When the patient lies on his side a strap passed round the shoulders and under the right thigh is a great assistance in the maintenance of the proper position. Curling recommends that the circumference of the tumour should be notched before the ligature is applied, in order to form a groove for this and to hasten the separation of the pile. The ends of the ligatures should not be cut off directly they are tied, as by drawing them outwards, when three or four ligatures have been fastened at various points of the circumference, a good view of the rectum is obtained. When all the piles have been tied, the ends of the ligatures must be cut off close, and the mass returned into the bowel. If there be much loose integument about the anus some of it may be removed by scissors, though this must not be recklessly practised. A pad of absorbent cotton is applied, and a T-bandage.

After-treatment.—The patient must be kept in bed until the ligatures separate, which occurs from the fifth to the eighth day. The diet should be a spoon one for a healthy adult, but a meat diet for the elderly or middle-aged. A full dose of opium is given to relieve pain, and if this be still severe, ice or, perhaps better, water as hot as can be endured must be applied to the anus. Retention of urine, if present, must be treated by the use of a catheter, warm hip baths, and a full dose of hyoscyamus and sp. æth. nitrosi. Spasm and tenesmus are best controlled by an opium enema, or a belladonna and opium suppository. The inguinal glands often become swollen and tender. At the end of three days a dose of castor oil should be given, and an injection of olive oil per rectum. Convalescence occurs in a fortnight. The raw surface left after the separation of the piles may be touched with nitrate of silver; if not healing, tr. benzoini co., or suppositories of morphia

gr. $\frac{1}{4}$, hydrarg. subchlor. gr. j, olei theobrom. gr. x, may be used. Death has occurred after this operation from pyæmia, tetanus, and effusion on the brain. Besides these dangers, objections to this operation are the subsequent pain, and difficulty in healing the resulting ulcers.

Secondary Hæmorrhage may be controlled by plugging the rectum with the smallest Barnes' bag, or rolling a sponge firmly and tying it in the middle with a piece of tape, the ends of which are left long. The sponge is trimmed with scissors to the size and shape of a hen's egg, and passed three inches up the rectum, the two ends of the tape hanging out at the anus. The lower end of the bowel is then plugged with pieces of cotton wool sprinkled with sulphate of iron, and the two ends of the tape are tied tightly over the cotton wool.

2. *Cautery*.—The best operation of this character is *Smith's Operation by the Clamp and Cautery*. The piles having been made to descend as usual, the tumour is seized by a pair of hooked or blunt forceps, and firmly held by an assistant. Smith's clamp is now carefully applied to the base of the tumour and the blades closed firmly with the screw. The surgeon then takes a sharp pair of scissors and cuts off the whole of the tumour: the cut surface is wiped and carefully and repeatedly touched by the heated iron, or Paquelin's thermo-cautery, until it is thoroughly cauterised. Smith in his later cases uses special serrated and cutting cauteries, with the blade capable of being set at a right angle with the shaft or parallel to it, to remove the pile and cauterise it at the same time, and has discarded the scissors. The screw is now loosened, and if there be any bleeding vessel the cautery is again applied; the clamp is then removed, and the other piles similarly treated. The finger greased with oil pushes the parts well up, and a suppository of 2 grains of opium is inserted. In performing this operation the tumours must be well brought down, or it is difficult to apply the clamp. When the skin must be included in the clamp as well as the mucous membrane, the scissors should be first applied at the point of junction. An eighth of an inch of tissue must be left above the clamp for the application of the cautery, which should be at a black

or dull red heat. The after-treatment is similar to that subsequent to ligature. This operation is particularly adapted to cases where either from age or the presence of co-existing disease the operation of ligature would be attended with danger, but may be adopted in any case in place of ligature. It is attended by less shock and followed by a more rapid recovery.

The Galvanic Cautery can be used to remove internal piles.

Paquelin's Thermo-cautery is recommended by Reeves. The piles being well protruded are punctured with a sharp point attached to Paquelin's thermo-cautery, and raised to a dull red heat. The cautery is rotated and gently withdrawn to prevent bleeding. One, two, three, or more punctures may be required, according to the size of the pile. After all the piles have been thus treated they are returned, and the usual after-treatment followed.

3. *Nitric Acid* is of great service in the treatment of strawberry and capillary piles. A speculum having been introduced, the acid is applied with a piece of wood or a glass rod to the part previously cleansed with lint. When the acid has acted sufficiently, the surface is wiped with a piece of lint saturated with prepared chalk and water, and the mucous membrane is smeared with oil.

4. *Crushing*.—Pollock has introduced a screw clamp constructed by Benham, by which the base of the pile can be completely crushed without bleeding, leaving only a slight fringed remnant. The clamp is left on the pile for three minutes; the hæmorrhoid beyond the clamp is removed by scissors. Tarred cotton, or salicylic cotton, is used as a dressing. The *écraseur* has been employed, but is apt to leave a stricture when the wound has healed.

5. *Injection* by a hypodermic syringe into the centre of the pile, of carbolic acid 1 part and glycerine 3 parts, or tr. ferri perchlor. mxx , is useful when the patient will not submit to one of the preceding methods of treatment. Gerard advises tannic acid 1 part, carbolic acid 2 parts, alcohol 4 parts, and glycerine 8 parts. Four drops should be injected into the *centre* of the pile. The injections will have to be repeated, and the treatment occupies many weeks. The pain is slight, and the patient should rest in bed for a few hours after the injection.

6. *Forced Dilatation* of the anus and sphincter, under an anæsthetic, by means of the operator's thumbs or a rectal dilator, will cause the piles to wither and disappear.

7. *Igni-puncture*.—By inserting a large heated needle into the pile in several different places.

8. *Excision* (Whitehead's Operation).—This consists in removing the strip of mucous membrane from the lower end of the rectum, from which the piles take their origin.—(1st Step.) The patient, previously prepared for the operation and under the complete influence of an anæsthetic, is placed on a high narrow table in the lithotomy position, and maintained in this position either by a couple of assistants or Clover's crutch.—(2nd Step.) The sphincters are thoroughly paralysed by digital stretching, so that they have no "grip," and permit the hæmorrhoids and any prolapse there may be to descend without the slightest impediment.—(3rd Step.) By the use of scissors and dissecting forceps, the mucous membrane is divided at its junction with the skin, round the entire circumference of the bowel, every irregularity of the skin being carefully followed.—(4th Step.) The external and the commencement of the internal sphincters are then exposed by a rapid dissection, and the mucous membrane and attached hæmorrhoids, thus separated from the submucous bed on which they rested, are pulled bodily down, any undivided points of resistance being snipped across, and the hæmorrhoids brought below the margin of the skin.—(5th Step.) The mucous membrane above the hæmorrhoids is now divided transversely in successive stages, and the free margin of the severed membrane above is attached, as soon as divided, to the free margin of the skin below by a suitable number of sutures. The complete ring of pile-bearing mucous membrane is then removed. Bleeding vessels throughout the operation are twisted on division. The incision must be made through mucous membrane and not through skin, none of which should be sacrificed. Iodoform is insufflated between the raw surfaces, and carbolised silk used as sutures.

Prolapsus Recti may consist either in the protrusion of the mucous membrane of the bowel only through the anus (partial), or in the protrusion of the

whole thickness of the gut (complete); in the latter case the prolapsed portion may be 6 to 8 inches or more in length.

Causes.—1. Debility, as in children and old persons. 2. Sympathetic irritation, as in stone in the bladder, enlarged prostate, stricture, phimosis. 3. Any obstruction or irritation of the rectum, as rectal stricture, chronic diarrhœa, dysentery, obstinate constipation, worms, pelvic tumours, or displaced uterus. 4. Hæmorrhoids or polypus.

Symptoms.—When the mucous membrane is alone protruded, it forms a more or less perfect ring, at first of a bright red colour, soft and elastic; if of old standing, it presents a livid hue, and is harder; the mucous membrane is continuous with that covering the sphincter. At first the prolapsus only occurs after defæcation, and is readily reduced, but as time passes it may habitually be present. There are uneasy sensations at the anus, with a mucous, bloody, or purulent discharge. When the prolapsus is complete, which as a rule only occurs in children and old persons, the tumour is cylindrical in shape, covered with florid vascular mucous membrane, secreting a bloody mucus; there is a deep groove between the protrusion and the margin of the sphincter. This form is due to an invagination of the bowel, the ensheathed portion being the middle or upper part of the rectum, or even the lower part of the sigmoid flexure. Irritability of the bladder, and sometimes retention of urine, are present; pain in the loins and down the thighs, with dyspeptic symptoms, follow. In chronic cases the mucous membrane becomes hardened, resembling skin, superficial ulceration is apt to occur, the sphincter and other muscles are relaxed, and the folds of skin round are loose, thickened, swollen, and pendulous. If the protrusion cannot be returned, it is liable to be constricted by the sphincter muscle, and become strangulated; the parts become thickened and livid, attended with extreme pain and retention of urine, and gangrene of the protruded mass will ensue. A complication, which is occasionally present, is the presence of a hernia in the recto-vesical or recto-vaginal pouch, which being drawn by the prolapsed rectum through the anus, may become strangulated.

Treatment.—In children, remove any local cause of irritation, as ascarides,

stone in the bladder, or phimosis, and pay attention to the general health. The prolapsus should always be returned by putting the patient in the recumbent posture, and with the right hand, well oiled, making pressure until the whole be reduced. If the protrusion be large, and has been some time down, a manipulation similar to taxis must be employed, the patient, if necessary, being under chloroform, and the surface of the tumour well oiled. This movement can be assisted by first passing a gum elastic catheter, with a strip of oiled lint wrapped round it, through the external opening, to act as a guide; inversion of the patient is sometimes an assistance. In obstinate cases subcutaneous division of the fibres of the sphincter muscle is a measure to be remembered, though I have never found this necessary. Having returned the gut, it will soon descend again unless prevented, and the best means to hinder this is to distend the rectum with a sufficiently long strip of oiled lint, and apply a pad or sponge and a T-bandage. Another plan is to apply a broad strip of thick plaster vertically over the anus to support the sphincter, and another strip to draw the nates together; after each evacuation a fresh strip is applied. Bryant recommends, in obstinate cases occurring in children, the application of the nitrate of silver in stick to the whole mucous surface, previously wiped with lint; this is often followed by the reduction and retention of the prolapse.

After-treatment consists in giving small doses of rhubarb and hydrarg. cum creta, a warm bath regularly, fresh air, a nutritious diet, and tonics. The child must be made to pass its motions whilst lying on its side. Injections of sulphate of iron (gr. iij to 3j), or alum ʒj, decoct. quercus ʒviiij; every morning after the bowels have been opened ijss should be introduced into the bowel. Langenbeck recommends the hypodermic injection of a solution of ergotin (5 to 15 parts to 100 of distilled water) into the cellular tissue after the bowel is replaced; this injection must be repeated every three or four days.

In adults the general treatment for piles is indicated. If the bowel cannot be returned by the patient, the surgeon must replace it, and it is advisable to smear over it solid nitrate of silver, or tan-

nic acid and glycerine, before reducing it. If piles or polypus be present, they must be cured by operation. Abscess of the liver has followed excessively violent efforts at reduction.

Operation for Prolapsus Recti.—In bad cases in adults some operative measure is needed. 1. Excision of the loose folds of the skin round the anus (Dupuytren). 2. Ligature (Copeland). 3. Clamp and cautery (Smith). 4. Nitric acid. 5. V-shaped incision (Robert).

1. *Excision of the loose folds of the skin* radiating round the anus is performed by seizing hold of a fold of skin with forceps, and removing it, together with mucous membrane, by curved knife-edged scissors. The edges of the mucous membrane are united by catgut sutures. The patient must be watched subsequently for fear of hæmorrhage into the rectum.

2. *Ligature.*—With the forceps a fold of mucous membrane is seized, and a ligature passed round it, as if it were a pile, the parts being then returned within the sphincter. This may be repeated as many times as is necessary. A double ligature transfixing the fold is the most secure.

3. *Nitric Acid* is good in cases of simple prolapse of the bowel, when there are one or more folds of mucous membrane, and the tissue is very vascular. The acid should be applied to only a portion of the membrane at one time.

4. The *Clamp and Cautery*, as used in internal piles, is excellent for prolapsus in adults. The cautery may be used also without the clamp. The patient is placed in the lithotomy position, with the prolapse reduced, a large-sized Sims' speculum is passed into the bowel, and with a Paquelin's cautery at a dull red heat, four lines are traced on the mucous membrane, commencing three to four inches from the anus, and ending at the junction of the skin and mucous membrane. The lines are situated in front, behind, and on each side.

5. *Robert* recommends two incisions, extending from the extremities of the transverse diameter of the anus to the tip of the coccyx. The skin, subcutaneous tissue, and a portion of the sphincter are removed in a V-shaped flap, and the edges brought together with sutures.

Fistula in Recto.—*Causes.* 1. Abscess

in the ischio-rectal fossa, the result of traumatic violence, exposure to cold, inflamed hæmorrhoids, or occurring in debilitated persons, more especially the phthisical. 2. Ulcers of the mucous membrane, followed by suppuration in the neighbouring tissues, arising spontaneously, or produced by the irritation of foreign bodies, as fish bones, or by fissure or stricture, etc.

Abscess in the Ischio-rectal Fossa readily occurs, and may be superficial or deep. The matter has a great tendency to burrow upwards beneath the levator ani muscle. Two forms are met, an acute phlegmonous abscess, and a chronic purulent collection: the latter often results from venous congestion due to disease of the heart, liver, or lung, especially phthisis.

Symptoms of the acute form.—Pains shooting through the anus, rectum, and perineum; tenderness on pressure; a hard, brawny swelling by the side of the rectum, filling up the hollow of the fossa, and easily felt by the finger in the bowel; erysipelatous blush of the skin; more or less fever and constitutional disturbance; bearing down, and a desire to evacuate the bowels, but only a little mucus passes with great straining; there may be constipation; irritability of the bladder, or retention of urine, is not uncommon. If the abscess be discharged, the matter has a distinct fæcal odour, even though there be no direct communication with the bowel. Rectal abscess points but slowly in the perineum by the side of the anus, and not unfrequently into the bowel also; occasionally at a distance, in the middle of the thigh, or backwards near the trochanter.

The Chronic Abscess is very insidious in its progress, with little or no pain, but slight swelling, and no fever. When the patient is not relieved, the abscess will discharge itself externally, internally into the gut, or both ways, a sinus being left discharging a thin pus, and not healing on account of the disturbance of the parts by the sphincter, and the occasional entry of a little fæcal matter into the abscess cavity. From the non-closure of the cavity of an ischio-rectal abscess, a fistula is left, which in most cases has only one external opening, situated half an inch from the anal margin, but it may be close to the anus. Now and then two or three apertures

exist, and these may be situated as far off the anus as the ischium, back of buttock, over the great trochanter, in the perineum, or even in the groin. The fistula usually runs a direct course obliquely from the external opening to above the sphincter, but may be twisted or angular. *In all cases of fistula, examine the bowel carefully for stricture.*

Varieties.—1. Complete, having both an external and an internal opening. 2. Blind external, with only an external opening, and no communication with the bowel. 3. Blind internal, when there is an opening into the bowel, but no external outlet.

Complete Fistula.—The external opening is generally small, with a projecting granulation, and a slight thin purulent discharge escapes from it. The internal opening is situated just above the sphincter, *about one inch or a little more* from the surface, though the sinus frequently extends much higher than this, terminating in a cul-de-sac, owing to the abscess having opened into the bowel by a hole in its side, and not at its highest point. The internal opening can be seen on passing a probe through the fistula, or injecting milk, the parts being exposed by the rectal speculum. There is generally only one internal opening, though two or more have been met with. The fistulous tracks after a time become lined by a layer of lymph, which closely resembles the mucous lining of the bowel. In consequence of irritation by fæcal matter, the skin becomes indurated and discoloured for some distance round the anus. The blind external form is recognised by the fact that a probe does not enter the bowel, but the mucous membrane is generally thinner at the spot where an internal opening should exist. The blind internal is more difficult to diagnose, but in these cases there is a discharge of pus from the anus, with a tender, painful, brawny swelling in one ischio-rectal fossa. By pressure, pus will exude, and on passing the finger into the rectum, the internal opening can be felt. It is to be remembered that sinuses close to the anus may be produced by pelvic abscess, hip-joint disease, disease of the prostate gland, necrosis of the ischium, sacrum, etc.

Treatment of Abscess.—Rest in bed. A purge of calomel and castor oil. Warm fomentations. Before fluctuation can be

perceived if the parts feel hard, and brawny by the side of the anus, pass the left forefinger, well greased, into the rectum, and then make a free incision, insert a drainage tube and apply poultices. If the sinus do not heal, inject it with tr. iodi. or tr. cantharides, pass a probe coated with nitrate of silver, or scrape with a Volkmann's spoon. When the fistula is complete, the only successful method of treating it is by division of the sphincter. The operation should not be performed when the fistula is occasioned by stricture of the rectum unless this can be first relieved, nor when caused by caries of the sacrum or coccyx, nor till the condition be somewhat chronic, nor in confirmed or advanced phthisis, nor in patients whose health is much broken down, or who are affected with disease of the liver or kidney.

Operations for Fistula in Recto.—1. By the knife. 2. By ligature. 3. By the galvanic cautery.

1. *By the Knife.*—The patient having had his bowels emptied by a dose of castor oil and an enema, lies on his left side with the nates projecting over the edge of the bed, and an assistant separating the buttocks. The surgeon introduces the finger, well oiled, into the bowel, having previously passed a probe through the fistula. With the probe as a guide, a blunt-pointed bistoury is passed along the sinus till its point projects in the bowel. The probe is withdrawn, the forefinger hooked over the end of the knife, and with a sawing and pressing cut the whole of the structures are divided, and both the finger and blade brought out of the anus. Afterwards all superficial sinuses should be slit up, scraped with a Volkmann's spoon, and their edges pared with scissors. With regard to the cul-de-sac above the internal opening of the fistula into the bowel, opinions are divided whether this should be slit up or left after division of the sphincter. I am strongly of opinion that this should be divided with scissors, or if reaching dangerously high for a cutting operation, an elastic ligature should be passed and tied tightly. Smith has drawn attention to the fact that a great division of the internal sphincter may be followed by incontinence of fæces; he advises the use of rectal bougies after the operation to prevent this accident.

If the fistula be a blind external one,

the knife is to be forced into the gut at the place where the part feels thinnest, and the operation then completed. In the case of a blind internal fistula, a bent probe is to be passed up the rectum and through the opening of the fistula, and made to project externally; on the point of this an incision is made and the operation then completed as usual. An indurated fistula is slow in healing, and a good measure is to make a "back cut," that is, reverse the knife and draw the blade through the tract of the fistula into sound tissue, extending this incision beyond the external orifice.

After-treatment.—Rest in the recumbent position. Dress the wound with oiled lint and a T-bandage. Give an opium suppository. The wound must be dressed from the bottom every day, and lotions of sulphate of zinc, sulphate of copper, tincture of iodine, or nitric acid used. If the wound do not heal, confection of black pepper and change of air are useful. The patient's constitutional condition must be attended to. To restrain hæmorrhage after the operation, clear out the coagula, use ice or hot water, inject liq. ferr. perchlor. (1 in 6), or sp. terebinth. The rectum may be plugged with lint steeped in one of the latter applications, round a lithotomy tube. (*Vide Hæmorrhoids.*)

2. *Ligature.*—This operation is done by passing an elastic ligature, by means of an eyed probe, through the fistula and tying it tightly, or passing the ends through a perforated shot, and crushing this with strong forceps; the ligature will then cut its way out. The advantages are avoidance of hæmorrhage, and its applicability when persons will not submit to a cutting operation. It is only fitted for cases of simple fistula.

3. *Galvanic Cautery.*—The wire is passed through the fistula and put in position before turning on the current, and then the wall of the fistula is slowly cut through, the adjacent parts being protected by a suitable speculum. There is no bleeding.

Ulcer and Fissure of the Anus.—Ulcers and fissures of the anus are divided into:—1. Those without the sphincter; 2. Those within the sphincter.

Causes.—They occur most frequently in women from obstinate constipation, uterine displacements, leucorrhœal or other irritating vaginal discharges, etc.

Chronic dysentery, diarrhœa, Bright's disease, syphilis, gonorrhœa, and tuberculosis, powerfully dispose to the occurrence of this disease. It is frequently associated with hæmorrhoids or polypus. In men it is most common in debilitated persons. Traumatic causes, as wounds caused by fish bones and the like.

Symptoms.—*Of those without the sphincter*, where the ulceration is confined to the surface round the anus, and on examination with the finger the rectum is found to be healthy, the symptoms are smarting on defæcation, and pain afterwards, *lasting only a few minutes.*

Of those within the sphincter.—1. Pain on defæcation of an exceedingly intense, burning character, increasing in severity, and lasting from a quarter of an hour to several hours; it then ceases, but returns when the rectum is next emptied. The pain is due to the passage of fæces over the raw surface. As the disease advances, pressure of any kind produces pain, the patient avoids an action of the bowel, and the constipation thus caused increases the suffering. 2. Spasmodic contraction of the anus, and flattening of the motions. 3. Discharge of mucopurulent fluid, with sometimes blood. 4. Reflex nervous pains in the perineum, thighs, loins, etc. 5. Sympathetic irritation about the genito-urinary organs, producing irritability of the bladder, with frequent micturition, or obstruction to the flow of urine, and in women uterine symptoms. 6. The general health fails. 7. On examination externally a small red pile is often visible; when the patient protrudes the parts on separating the buttocks, the ulcer will be seen at the base of the pile. The ulcer is usually of small size, circular or oval, and situated at the posterior border of the anus, near the coccyx, just above the ring of the sphincter, and may have a fissure extending from the sore across the sphincter. Allingham observes that a gelatinous or fibrous polypus often accompanies the fissure, situated at its upper or internal end, and occasionally on the opposite side of the bowel. Smith writes: "When the ulcer is situated on the anterior portion of the bowel, a polypus should be suspected." The same surgeon refers to the association of ulcer and internal fistula. If the parts cannot be exposed to view, a rectal speculum

must be used, or the finger introduced, when a small, soft, velvety patch will be detected, touching which produces severe pain; owing to the spasmodic state of the sphincter, an anæsthetic may have to be administered.

Treatment.—When the disease is external to the sphincter, the patient must rest in bed; the parts must be well sponged three or four times a day with warm water; the bowels attended to by sulphate of soda or castor oil. As local remedies, nitrate of silver, in stick or solution; black wash; sulphates of zinc or copper; ung. hydrarg. rub.: Cripps recommends ferri. subsulph. gr. x, ung. petrol. ʒj, as an ointment; Quain prefers hyd. c. cret. ʒss, ung. simplex ʒj; Allingham advises the following prescription:—

R Hyd. subchlor. gr. iv
Pulv. opii gr. ij
Ext. belladonna gr. ij
Ung. sambuci ʒj.

The following suppositories, as recommended by Erichsen, are useful: Ext. belladonna, gr. ij, plumb. acet. gr. ij, tannin gr. iv. Iodoform in powder or ointment is of service. When the ulcer is without the sphincter the application of the remedies may be successful. Dr. Mendel, of Essen, advises that the fissure should be cauterised with nitrate of silver, and then painted immediately with a 5 per cent. solution of cocaine; he then uses the following ointment:—

Acid. borac. 2 parts
Cocain. mur. 1 part
Lanolin 20 parts.
Misce. Ft. ung.

This is applied with the fingers several times a day, especially after defæcation, and retained by a pledget of lint. The bowels are kept open by Epsom or Carlsbad salts, and the base of the fissure cleansed several times a day by washing with a 3 per cent. solution of boracic acid.

In more severe cases an operation is required.

Operation.—The patient is anæsthetised, the bowels having been well emptied previously; the sphincter is forcibly dilated, the surgeon introducing his two thumbs back to back into the rectum, and then forcibly separating them from each other until the sides of the bowel can be stretched to the tuberosities of the ischium. The left forefinger

is inserted into the rectum, and then a narrow-bladed, straight, probe-pointed knife, guided by it above the ulcer; a cut is then made through the centre of the sore or fissure, including the whole length, for one-quarter or one-eighth of an inch in depth. The small pile and any loose flaps of skin are also to be removed.

After-treatment consists in keeping the bowels open with a mixture of olive oil ℥j, carbonate of potash grs. vj, aqua chloroform. ℥j, t.d.s. Rest in bed is imperative until the wound have healed, which must be dressed and treated as that of fistula.

Stricture.—Stricture of the large intestine is of two kinds: 1. Simple; 2. Malignant.

Simple Stricture.—Seat: Most commonly one inch or $1\frac{1}{2}$ inches from the anus; next two to three inches from the anus, occasionally four or five inches, and now and then at the junction of the sigmoid flexure and the rectum.

Nature.—It is due to fibrinous exudation in the submucous cellular tissue, with thickening of the coats of the bowel; occasionally it is due to the formation of fibrous bands stretching across the bowel. It may affect the whole or a portion of the circumference of the bowel, and varies in extent from a few lines to three or four inches in length. The disease has a tendency to extend inwards and result slowly in complete obstruction, or this may come on suddenly. Above the stricture, the bowel is distended, the mucous membrane is hypertrophied and vascular, or ulcerated and discharging. Abscesses may form, or ulceration and perforation occur communicating with the vagina, urethra, perineum, or peritoneal cavity, and producing fistulæ. If the stricture be above the anus, the mucous lining of the lower part of the bowel is congested and inflamed, resulting in catarrh, hæmorrhoids, prolapsus, and fistula.

Causes.—It may be congenital, or following an operation for imperforate rectum. Inflammation of the coats of the bowel arising spontaneously or from the irritation of hard fæces, foreign bodies, etc. From the cicatrization of wounds, whether accidental or inflicted by the surgeon in treating piles or prolapsus. Contraction consequent on the cicatrization of an ulcer (as from dysen-

tery, struma, etc.). Syphilitic ulceration is a common cause. Chronic catarrh of the bowel, or pelvic cellulitis, may also produce it. In women, difficult parturition occasionally leads to this disease.

Symptoms.—1. Painful and difficult defæcation, the patient having to strain violently. 2. Fæces altered in character, flattened, or consisting of small round masses. 3. *Constipation, with symptoms of diarrhœa*, the fluid matter being discharged remarkably forcibly two or three times a day, whilst the solid is retained. Such spurious diarrhœa is very analogous to the dribbling of urine which denotes retention. Smith writes: "Never neglect an examination of the rectum with the finger or bougie in an instance of long-continued and uncontrollable diarrhœa." 4. A discharge, more or less constant, of mucus, blood, and pus, accompanied by an uneasy sensation about the rectum. 5. Sympathetic irritation about the bladder and reflex pains in the loins and down the thighs. 6. Dyspepsia, with flatulent distension of the abdomen, emaciation, and hectic. 7. On examination with the finger, the stricture will generally be easily felt; should it be out of reach, the patient must strain or stand up; if then it cannot be felt, an olivary-headed sound, or a wax or gum elastic bougie may be passed. Care must be taken not to pass the finger or bougie through the stricture, as the walls of the rectum are often as thin as tissue paper, and perforation may occur. 8. In doubtful cases, the sphincter being dilated and the patient anæsthetised, the surgeon may pass his left hand, well greased, into the rectum, pressure being made with the right hand on the left iliac fossa. When there is ulceration the stricture is liable to attacks of inflammation, which may result in complete obstruction; perforation may cause death, and this event may occur in the cæcum, which is apt to be much distended in these cases. Fistula in recto is a common complication of stricture.

Treatment.—Attend to the diet and administer laxative purgatives, gradual dilatation by wax bougies in slight strictures, or those which are very painful, or where there is much discharge. Laminaria or sponge tents are useful. Gum elastic bougies, conical bougies, metal bougies, are all of service, the latter especially in tight strictures. Todd's

dilator is useful. Agnew advises a long pair of forceps. Furneaux Jordan recommends continuous dilatation by means of a fine urethral bougie, worn for some hours daily.

In gradual dilatation a bougie should be carefully introduced into the stricture every second day, and left in for fifteen minutes; never use too forcible efforts to overcome the strictures nor cause pain, and select an instrument which will pass easily, gradually increasing the size of the bougie. After dilatation, an opium suppository is to be inserted, and the patient should rest in bed for some hours. If the stricture be of syphilitic origin, give small doses of mercury and iodide of potassium.

Internal Division of the Stricture, or Internal Proctotomy.—When the stricture is a narrow band and very unyielding, it may be necessary to make a few nicks in it at various points with a straight blunt-pointed bistoury, guided by the left forefinger, and introduce a sponge tent for twelve hours; afterwards bougies are to be passed. When situated low down, a curved trocar and canula may be passed through the stricture, and when above this, made to pierce the structures posteriorly, piercing the skin, and appearing below the coccyx. The trocar is withdrawn, and the wire of an écraseur introduced through the canula, which is removed, and all the strictures included in the wire divided; a galvanic cautery may be used. When the stricture is out of reach of the finger, the bougie must be passed with the greatest care, observing not to mistake the valvular folds of the gut, or the sacral prominence, for the stricture, and to avoid all injury to the coats of the bowels. When full dilatation is effected it will be necessary for the patient regularly to pass a candle well oiled or the stricture will return; in traumatic cases this should be done daily, in other cases weekly. Electrolysis, by means of a rectal bougie attached to the negative pole of a continuous battery, will often much aid dilatation.

Linear Proctotomy, with Complete Division of the External Parts, is serviceable when the stricture is low down. The bowels are opened by castor oil and an enema. The patient is placed in the lithotomy position and anaesthetised. The surgeon passes his left forefinger

through the stricture, and if this be too tight it must be divided by a blunt-pointed bistoury. A long, curved, strong, sharp-pointed bistoury, with the point protected by the finger nail, is passed through the stricture and made to transfix the rectum well behind the contraction, coming out externally through the skin at the tip or side of the coccyx. The parts are cleanly divided by cutting downwards to the anus. This incision must be kept in the middle line of the posterior part of the rectum; if all the stricture be not divided, a probe-pointed bistoury or scissors is used to complete the division. Any bleeding vessel is ligatured, and the wound dusted with iodoform and packed with lint; a sponge dressing is applied outside this. After ten days a bougie is passed.

Colotomy in the left lumbar region is necessary in cases where there is much ulceration, in strictures out of reach of the finger, in tubular strictures, or in those complicated with fistulae or sinuses. If sudden obstruction occur, the parts must be examined, and if the stricture be very narrow it may be cautiously incised and dilated. All foreign bodies must be removed by the fingers or forceps. Injections of gruel or linseed oil, by means of a long tube passed, if possible, through the stricture. If the tube cannot be passed, lumbar colotomy must be at once performed.

Malignant Stricture is generally met with in males at the middle period of life.

Seat.—Generally at the lower portion of the rectum, within reach of the finger.

Nature.—As the result of some irritation, Lieberkühn's follicles become enlarged, with hypertrophy of the mucous and muscular coats, and infiltration of submucous tissue with leucocytes, forming the superficial adenoma of Klebs. The next step is destruction of the limiting membrane, and invasion by the epithelial cells, by means of the lymph channels, of the other coats of the bowel, the peri-rectal tissues, and neighbouring organs, the growth being now a cancer. The growth may occur between the mucous and muscular coats, or more rarely between the muscular and serous layers. The mucous membrane becomes raised up in nodules, which ulcerate, forming a

fungous mass, very vascular and liable to slough. The disease spreads upwards and downwards for four to six inches. The most frequent variety is the adenoid or cylindrical epithelioma, which may be spread as a thin layer between the mucous and muscular coats, or form a distinct tumour by advancing uniformly in all directions. Encephaloid, colloid, melanotic carcinoma, scirrhus, squamous epithelioma (at anus), and sarcoma are also met with. Neighbouring organs may be affected, producing fistulæ, communicating with the vagina, bladder, or urethra. Sometimes the rectum is secondarily implicated by the disease spreading to it from neighbouring organs, this being most frequent in women, owing to the proximity of the womb. The liver and lymphatic glands connected with the bowel are apt to be attacked with secondary deposits.

Symptoms.—At the commencement, uneasiness about the bowel, difficulty in defæcation, spurious diarrhœa, discharge of bloody mucus. Next the pain increases, and with each motion a considerable quantity of blood is discharged. The pain extends to the loins and down the thighs, nates, perineum, and sacrum, and is very severe, with a feeling of weight in the pelvis, so that the patient avoids an action of the bowels. Dyspepsia with emaciation and cachexia ensue. As the disease progresses the obstruction increases, with constant desire to defæcate, and the passage of liquid stools and pus, this being often involuntary. The bladder is usually irritable, and retention may occur. Abscesses form at the side of the bowel, leaving fistulæ. If the anus be affected the sufferings are very acute, but when the disease is confined to the rectum, at some inches distance from the anus, the symptoms are not well marked, and the suffering is comparatively slight. When the disease is well established the patient may find it impossible to sit down. On examination with the finger a ring will be felt, but much harder and more extensive than in simple stricture; the bowel is adherent to the surrounding structures; and the discharges are more offensive, copious, and dark (coffee-ground discharge) than in the simple form; later on, the rough, indurated, irregular, nodular mass can be felt; or an ulcer with a firm base and abrupt hardened edges. Death

generally follows in from one to four years.

Diagnosis.—Cripps lays down as the chief points of diagnostic value between simple and malignant stricture: 1. Time. He writes: "I know of no instance of malignant disease in which the patient has survived a couple of years after the symptoms of stricture became prominent. Indeed, as a rule, the time is far less than this, the survival even for a year being very exceptional. It may be safely assumed, therefore, that if well-marked symptoms of stricture have existed for a couple of years, that it is improbable the case is one of cancer." 2. Condition of the bowel between the strictured part and the anus. In malignant disease this is generally healthy, in fibrous stricture this part of the bowel is somewhat hard and contracted, portions of its mucous membrane are often hard and creaky, as if replaced by cicatricial tissue. 3. Condition of the inguinal glands. If these be enlarged the stricture is probably malignant, though in many cases of malignant stricture the glands are unaffected. 4. Presence of cachexia.

Treatment.—Attend to the bowels by mild aperients, or oil and water enemata. Suppositories of morphia gr. $\frac{1}{2}$, and ext. hyoscyami gr. x, every night; and, if necessary to relieve pain, opium by the mouth. Injections of warm oil, starch and opium, or decoction of poppy, cautiously administered with a Higginson's syringe and a No. 8 catheter, are soothing. A nourishing diet without vegetables, consisting of plain meats, soups, eggs, and milk, with toast or biscuit instead of bread. Keep the parts clean and well dusted with oxide of zinc, and starch. To check discharge, injections of sulphate of copper and opium, or solution of chloride of zinc well diluted. To prevent fætor, carbolic acid solution, or permanganate of potash. Scraping the raw surface, and applying the actual cautery, is a useful temporary expedient, and will give relief for some months. The best palliative is lumbar colotomy when the pain is severe, fistulæ have formed, communicating with the bladder or vagina, or obstruction is present. Excision of the rectum should be performed in suitable cases. Cripps mentions the following essential conditions: 1. The disease must be within four

inches of the anus, and in women must not have extended on the anterior wall more than three inches; 2. Rectum must be fairly movable on the subjacent parts; 3. Liver must be unaffected.

Polypi of the Rectum are not very common. They are of five kinds: adenomatous, villous, myxomatous, vascular, and disseminated. The growth is most frequent in children under twelve, and is generally situated about three inches from the anus. Most frequently the polypus is single, but may be multiple, and vary in size, from a raspberry to a hen's egg.

Symptoms.—The chief one in children is hæmorrhage from the bowel, especially during defæcation, and this should always make the surgeon suspect a polypus; other symptoms, as tenesmus, copious mucous discharges (like thin currant jelly), prolapsus, and reflex disturbances of the genito-urinary organs, are present. The growth may protrude during a motion, and be nipped by the sphincter. In adults there is no hæmorrhage, and the polypus, which is usually of a firm, dense, fibroid character, must be recognised by the other symptoms. The growth is slow, and it is not malignant. Ulcer or fissure, hæmorrhoids and prolapsus, are often associated.

The best treatment is to ligature the neck of the polypus, as there is a liability to fatal bleeding if the neck be not secured; or the *écraseur*, or clamp may be used.

Excision of the Rectum is used for cancerous and other strictures of the rectum. A metal catheter is introduced into the bladder, the bowels having been well cleared out with a purgative and warm water, and the patient anæsthetised, and placed in the lithotomy position, with the legs drawn up, and fixed on the abdomen with a Clover's crutch.

Instruments required.—1. Strong, curved, sharp-pointed bistoury. 2. Straight bistoury. 3. Blunt-pointed scissors. 4. Strong, curved scissors. 5. Two pairs of large vulsellum forceps. 6. A steel wire *écraseur*. 7. Paquelin's cautery. 8. Artery forceps. 9. Ligatures.

The left forefinger being passed into the rectum, the tip of the coccyx is felt, the curved bistoury, held in the right hand, is passed into the bowel, guarded by the finger nail, the handle of the knife is raised, and the point made to

protrude through the skin on a level with the tip of the coccyx. The whole of the intervening tissue between the puncture and the anus is divided, exactly in the middle line. The left hand of the operator is now placed on the right side of the buttock, so as to draw the anus outwards, a crescentic incision is made with the knife, using firm pressure, commencing at the margin of the anus, and extending laterally round this to a point in the middle of the anterior border. The forefinger thrust into this incision separates the rectum from the surrounding tissue, except the insertion of the levator ani, which is divided by scissors. Hæmorrhage is restrained by a sponge, and a similar cut made on the other side. The anterior part of the rectum is separated from the adjacent structures with the knife and scissors, the rectum being drawn backwards and downwards. The bowel is drawn down with vulsellum forceps, and the wire loop of the *écraseur* passed over the forceps and the detached gut, and slowly tightened until the diseased portion of the gut be removed. The scissors may be used instead of the *écraseur*. All bleeding vessels are ligatured, and the ends of the ligatures cut short. A drainage tube is inserted, and the integument drawn together by suture. A large sponge, kept in position by a T-bandage, is the best dressing. Condyl's fluid should be used to keep the parts as aseptic as possible. Incontinence of fæces, though present at first, generally disappears. It is advisable to perform lumbar colotomy previous to this operation.

Pruritus Ani consists in an intolerable itching about the anus, occurring especially at night when the patient is warm in bed, and also in cold weather.

Causes.—Local: Thread-worms, pediculi, vegetable parasites, chafing of the nates and retention of glandular secretion in fat subjects, external hæmorrhoids, catarrh of the rectum, prolapsus, polypus, stricture, fissure, eczema.—General: Gout, lithic acid diathesis. It is most common in middle-aged or elderly persons, especially the dyspeptic.

Treatment.—If gout or lithic acid be present,

R Magnesia gr. vj
Potass. bicarb. gr. xv
Potass. tart. gr. xv
Aq. ad ʒj. T.d.s.

Or,

Lithiæ carbon. gr. iv
Aq. ad ʒiv

Regular diet and exercise. If pediculi be manifest, a mercurial ointment, or carbolic oil. For thread-worms, injections of perchloride of mercury solution or salt. Locally, a lotion of borax, acid hydrocyanic, morphia, and glycerine. An ointment of camphor ʒj, chloral ʒss, sp. vini rect. q.s., adeps ʒj is useful. Bichloride of mercury gr. ij, aqua calcis ʒj, is valuable. Bathing with very hot water. Curling recommends sulphuret of potassium ʒj, aqua calcis ʒviiij, as a lotion. Counter-irritation by blisters to the iliac region is often of service. I have cured obstinate cases with the galvanic current. Nitrate of mercury ointment, diluted with two parts of vase-

line. Iodoform suppositories. Sulphate of zinc and alum placed in an earthen vessel, and heated sufficiently to drive off the water of crystallisation, or until they become a confluent hard mass. From half a drachm to one drachm of this substance, powdered and dissolved in a little water, should be thrown into the rectum. In a few minutes it will destroy the itching (Agnew). Internally, iron, with perchloride of mercury and liq. arsenicalis. Quinine, strychnia, bromide of potassium with the iodide, is serviceable in nervous cases. In very obstinate cases, Gross recommends slight ptyalism, maintained for several weeks. If all treatment be ineffectual, the actual cautery superficially applied under an anæsthetic.

CHAPTER XXXIV.

URINARY ORGANS.

Diseases of the Urethra, Penis, and Scrotum.

Urethritis is an inflammatory affection of the mucous membrane of the urethra, producing a muco-purulent discharge.

Causes.—1. Direct contact with the specific poison in the discharges of a person suffering from the same disease. This is by far the most common cause, and the disease is then termed *gonorrhœa*. 2. Irritating discharges in the female, *irrespective of gonorrhœa*, may give rise to a urethritis in the male, especially if the urethra be unduly intolerant. The woman may be suffering from leucorrhœa, or may be menstruating, etc. 3. From constitutional causes, as gout, rheumatism, struma, tubercular disease, etc. Occasionally a slight urethritis is met with, accompanying the early skin affections of syphilis. 4. Irritation from excessive sexual intercourse, drunkenness, the passage of instruments, a foreign body, or calculus, etc., in persons the subjects of stricture, enlarged prostate, or in those who have an irritable urethra. 5. From ordinary sexual intercourse. 6. Certain medicines, as guaiacum, cayenne pepper, turpentine and cantharides.

Gonorrhœa only will be considered, as the other forms of urethritis possess no distinctive characters, except a less degree of severity.

Seat.—It commences at the fossa navicularis and spreads backwards to the bulbous and membranous parts of the urethral mucous membrane. The chief seats are two inches from the meatus and at the bulb.

Symptoms.—*First Stage—Irritation.* This occurs from three to five days after infection. It is characterised by itching, redness, heat, and smarting during micturition, together with a slight serous discharge.

Second Stage—Inflammation.—Severe burning pain on passing water. Frequent micturition both by day and night. Copious thick, cream-like, greenish yellow discharge. Pain in the groin and perineal region. Painful erections and chordee, or a twist in the penis, due to exudation of lymph in the corpus spongiosum, or in other cases from spasm of the muscles subsequent to irritation of the branches of the pudic nerve. The lips of the meatus are red and swollen; prepuce often slightly œdematous; and the glans

congested, glossy, and enlarged. The patient is feverish. This stage lasts from one to three weeks.

Third Stage—Decline.—The discharge diminishes, becoming thin and muco-purulent; the pain and scalding cease, and under proper treatment for a fortnight the discharge may stop entirely, but in some cases it remains for a long period, and is then termed a *gleet*. If the disease become a gleet, in time the general health is affected, the patient becoming pale, debilitated, and unfit for work. *As long as there is the slightest discharge, the disease is contagious.*

Complications.—Balanitis, posthitis, phimosis, paraphimosis, retention of urine, inflammation of the lymphatics and glands, hæmorrhage from the urethra, lacunar abscess, prostatitis, cystitis, epididymitis, gonorrhœal ophthalmia, gonorrhœal scleritis, warts, rheumatism. Very rarely, pyæmia, pyelitis, nephritis, pelvic cellulitis, and peritonitis.

Treatment.—The remedies for gonorrhœa are threefold: first, antiphlogistic measures, to get rid of inflammation; secondly, certain medicines containing a volatile oil, which has a peculiar sanatory influence on the inflamed mucous membrane; and thirdly, astringents to check the secretion of the inflamed surface. The so-called abortive treatment, which consists in the injection of strong caustic solutions and large doses of copaiba or cubebs, can only be employed in the stage of irritation, and is of no earthly use.

In the second stage—*Rest in bed* is the best curative measure, and should always be adopted if possible. Avoidance of all alcoholic liquids, smoking, sexual excitement, and exercise. The diet should consist of skimmed milk, raw eggs, and dry toast. The patient should drink freely of barley-water, linseed tea, and potash water. The bowels must be kept open.—*Locally:* Water as hot as can be borne to the genitals, though in some cases immersing the penis in ice-cold water or surrounding it with Otis' coil will give more relief; as regards this it is best to consult the patient's feelings. Internally, give a mixture of bicarbonate, citrate, or acetate of potash, with nitrate of potash, tr. hyoscyami, tartrate of antimony ($\frac{1}{12}$ to $\frac{1}{6}$ gr.) and sp. æth. nit. every four hours after meals. Pain in mic-

turition, which is sometimes severe, can be relieved by the injection of a 4 per cent. solution of cocaine into the urethra before passing water: the injection of ice-cold water or the application of the india-rubber coil is often of service, or wrapping the penis in lint wet with a lotion of tr. aconiti, tr. opii, sp. vin. reet. aa ʒj, liq. plumb. subacet. dil. ʒij; in rheumatic or gouty individuals hot water is preferable.

Chordee is relieved by camphor with extract of belladonna; opium (gr. j) with camphor (gr. iij) in a suppository is often of service, or opium and camphor combined in a pill. Cold to the penis and leeches to the perineum are valuable adjuncts. Other remedies which are sometimes of service are strychnia ($\frac{1}{30}$ to $\frac{1}{24}$ gr.) chloral, lupulin, bromide of potassium, tr. gelsemii, ergot, tr. cantharides, (m j, t.d.s.). In a first attack of gonorrhœa, Furneaux Jordan recommends acetum lyttæ painted in small patches over both femorals, combined with a disc or broad zone of iodine liniment, and applied daily. In the third stage, when pain in micturition and urethral tenderness have ceased, specifics are valuable; these being: balsam copaibæ, cubebs, oil of yellow sandal wood, gurjun balsam, balsam of Peru, creasote, and kava kava. Copaiba (ʒss) may be given with mucilage, infusion of roses, and sulphuric acid dil. (m xv); in capsule; or in mucilage with liquor potassæ and tr. hyoscyami. Gross recommends it being given in an emulsion prepared by rubbing the balsam up in gum arabic and extract of liquorice, to which are afterwards added camphor water and spirit of æther nitre with a little tincture of opium. Cubebs (ʒj to ʒij) in milk or made into an electuary with copaiba. Oil of yellow sandal wood may be administered in mucilage, or Hewlett's mixture, which is a reliable and convenient form, the drug being combined with buchu and enebbs. Vidal recommends gurjun balsam ʒj, acacia gummi ʒj, infusion of aniseed ʒx; to be divided into two doses and taken immediately before meals. I have found this a most valuable remedy, succeeding where other means have failed. The specific remedies will sometimes produce disagreeable and undesirable results; thus copaiba will cause a rash resembling that of measles, dyspepsia,

and renal irritation; santal oil may give rise to dyspeptic symptoms, gastro-intestinal irritation, urticaria, and severe congestive pains over the kidney. These drugs should not be given on an empty stomach, and should be discontinued if troublesome symptoms arise. A warm bath is also useful in preventing their occurrence.

*Injecti*ons are useful in this stage. A glass syringe two inches long should be used, with a smooth rounded nozzle half an inch long. The patient, having passed water, puts the nozzle into the urethra and pinches the sides of the glans with the left thumb and forefinger; the piston is pressed down with the right forefinger, and the nozzle withdrawn, the patient still nipping the penis to prevent the escape of the injection, and rubbing along the course of the urethra; after two minutes, on relaxing the hold of the penis the injection is forcibly discharged. If the injection produce pain, smarting, or burning, it must be diluted or changed for a milder one; the most important point is to begin with a very weak solution, and gradually increase its strength. Many drugs are used for injections, the following being some of the best. If there be still some pain and inflammation, bismuth subnit. gr. vj with mucilage ʒj; opium and belladonna in glycerine; or plumbi acetate gr. ij to ʒj. Afterwards:—Liq. potass. permang. m iv to ʒj; hydrarg. perchlor. gr. ¼ to j; sulphate of zinc gr. ij-v to ʒj; acetate of zinc gr. iij to ʒj; chloride of zinc gr. ¼-½ to ʒj; glycerine of tannic acid ʒij to ʒj; nitrate of silver gr. j-ij to ʒj; quinine gr. iv to ʒj; chloral gr. v to ʒj; gallic acid gr. ij to ʒj; sulphocarbolate of zinc gr. ij to ʒj. Ricord's injection is very efficacious; it consists of sulphate of zinc and acetate of lead gr. v āā to f. ʒj. The injection should be used three times a day, and it is important to change it from time to time, as it loses its effect on the mucous membrane. Soluble bougies of eucalyptus or iodoform are sometimes of service.

Gleet is often very troublesome to treat. The patient's habits must be regulated carefully. Besides the before-mentioned treatment for the third stage, the passage of a catheter, two or three times, is serviceable. If the patient be debilitated, tincture of the perchloride of iron with nux vomica, or tincture of cantharides;

mineral acids; syr. ferri phosph. co.; sp. terebinth; matico; Canadian balsam; sulphate of zinc. A generous diet is often required, with ale, stout, wine, or Hollands gin. Change of air and sea bathing will sometimes do good. Pencilling the whole course of the urethra along the under surface of the penis with tincture of iodine, and blistering the perineum. The application of ergotin, or nitrate of silver (gr. xx to ʒj) by a catheter syringe to the inflamed patch of the urethra. In obstinate cases irrigation of the urethra with astringent lotions by means of a large-eyed catheter inserted nearly into the bladder, and connected with a Higginson's syringe. Ricord's favourite lotion was iodide of iron gr. j to fʒj. Galvanism of the urethra with a urethral electrode connected with the negative pole, using a current of from two to seven milliamperes, whilst a sponge electrode attached to the positive pole is applied to the lumbar region.

In treating gonorrhœa it is necessary to persevere with the treatment for at least a week after all discharge has ceased, or the disease is nearly certain to return.

Complications.—*Balanitis* is an inflammation of the surface of the glans penis, and is generally accompanied by *posthitis*, or inflammation of the inner surface of the prepuce; it is frequently met with in cases of gonorrhœa, or other venereal affection, in persons who have a long narrow foreskin; it may arise from simple irritation, produced by want of cleanliness, or retained secretions, etc. The symptoms are itching, pain, and tenderness; some amount of purulent discharge; an abraded appearance of the affected surface, together with superficial ulceration: a swollen, œdematous condition of the prepuce.

Treatment.—Injections between the glans and the prepuce of black wash, alum, tannic acid, tr. iodine, lead lotion, or lime water, with salines internally. In obstinate cases the application of solid nitrate of silver, or painting with a strong solution of the same.

Phimosis and Paraphimosis (*vide* Diseases of the Penis).

Retention of Urine is usually due to congestion of the urethra and spasm of the muscles; in some cases an old stricture may be also present.

Treatment.—Opium suppositories or the hypodermic injection of morphia and atropine (gr. $\frac{1}{120}$). Inject into the urethra cocaine hydrochlorate gr. j dissolved in 3j of water and alcohol. Leeches to the perineum, warm bath, and purgatives should be tried, and then if necessary the passage of a flexible No. 6 catheter; the latter may be tied in if there be much difficulty in introducing it.

Inflammation of the Lymphatics and Glands.—The lymphatics along the dorsum of the penis may be affected, and can be felt to be enlarged; abscess or solid œdema and induration may follow. When the glands are affected, a sympathetic bubo results.

Treatment.—Complete rest; counter-irritation with iodine or blisters; mercurial inunction; small doses of liq. hydrarg. perchlor. internally.

Hæmorrhage from the Urethra occurs in chordee or during violent erections, the blood flowing independently of the stream of urine.

Treatment.—If profuse, injections of iced water, or diluted perchloride of iron, irrigation coil, and in obstinate cases, passing a catheter and compressing the penis on this with a narrow bandage.

Follicular Abscess arises from suppuration of a follicle or Cowper's gland; it may burst internally or externally, or form a perineal abscess. Prostatitis, cystitis, epididymitis, gonorrhœal ophthalmia, and sclerotitis are described under their respective organs (*q.v.*).

Warts as the result of gonorrhœa occur on the glans and behind the corona.

Treatment.—Snip off with scissors, and apply caustic. If large, use the galvanic cautery, or Paquelin's thermo-cautery. The best caustics are pure carbolic acid, nitric acid, glacial acetic acid, or chromic acid. A strong solution of acetate of lead applied daily will cause the wart to disappear without pain. Calomel (3 parts) and gallic acid (1 part) is a good absorbent powder.

Gonorrhœal Rheumatism is very obstinate, commonly affecting the muscles and fasciæ, but in some cases the joints are attacked. In the first form the usual seats are the hips, shoulders, thighs, and soles of the feet; in the second, large joints are attacked, knees, ankles, wrist, and elbow. The pain is worse at night, little fever, no sweating. The joint affec-

tion may be acute or chronic. This disease depends on the absorption of matter from the inflamed urethra; a similar affection is met with in women suffering from leucorrhœa, and in children affected with ophthalmia neonatorum.

Treatment.—Fixation of the joint by splints or plaster of Paris, followed by an india-rubber bandage, or cotton wool and a starch bandage. Ankylosis may occur. The general treatment consists in the administration of quinine or salicylate of soda in large doses, followed by iodide of mercury, or iodide of potassium; if these fail, cubebs and copaiba with sulphur baths. A generous diet with stimulants is required. Locally, extract of belladonna may be smeared over the painful joints, followed by blisters or iodine liniment externally.

Gonorrhœa in the Female commences in the vagina, spreading to the vulva, urethra, and uterus.

Symptoms.—The vagina is red, hot, swollen, and tender, and secretes a discharge at first of muco-pus, afterwards of pure pus. The mucous membrane of the vagina assumes a granular aspect (vaginitis granulosa). When the vulva is affected, the labiæ and clitoris are red and swollen, and exude a fetid purulent discharge. If the urethra be attacked, it is tender, the meatus is red and swollen; on pressure some discharge will appear, and there is a burning pain on passing water. In the uterus the cervix is the seat of the inflammation, the os is red, swollen, and may be abraded, and a tenacious muco-purulent discharge is poured out.

Diagnosis.—It is impossible to diagnose gonorrhœa from discharges in women arising from other causes, but if the urethra be affected independently of the vulva and vagina, gonorrhœa is, in all probability, the cause. The discharges produced by gonorrhœa are also more prolonged and severe than those arising otherwise. Children often suffer from vaginitis with discharges as a result of constitutional or local causes, and this may give rise to unfounded charges of rape. The surgeon cannot be too cautious in expressing an opinion in such cases.

Complications.—Abscess of the labiæ, metritis, perimetritis, ovaritis, hydrosalpinx, pyo-salpinx. Warts are common. Scanty menstruation is often met with.

Treatment.—When acute, rest in bed, warm baths, low diet, salines, and emollient sedative fomentations. Afterwards vaginal injections in large quantities applied by a Higginson's syringe, the same drugs being used as in the male, but three or four times the quantity to the ounce. The parts must be kept from friction by the interposition of a piece of lint wet with lotion. In some cases plugging the vagina with iodoform gauze, or strips of lint steeped in astringent lotions, and changed three times a day, is a useful measure. I have seen good results from packing the vagina with alternate layers of boric acid in powder and iodoform gauze; this is especially useful if the uterus be also implicated. Specifics are of no use unless the urethra be alone affected, which is very rarely the case. The application of nitrate of silver is excellent if the urethra or cervix uteri be implicated.

Malformations of the Urethra.—These are principally epispadias (*vide* Malformations of the Bladder) and hyposadias. The latter consists in the floor of the urethra being deficient. In slight cases the frænum is wanting or bifurcated, and the prepuce absent at the under part of the glans, but often redundant above. The body of the penis is generally curved downwards from rigid fibrous bands, which form the under surface of the corpora cavernosa; this is best seen during erection, and may be sufficient to prevent coition. The corpus spongiosum is more or less deficient and imperfect. The meatus presents a transverse valvular aperture, and is often contracted. It may occupy one of three situations: firstly, it may open just behind the frænum; secondly, between the frænum and the scrotum; thirdly, in the perineum. In the latter case the scrotum is generally cleft, its two sides each containing a testicle closely resembling the labiæ majores of the female, and the urethra terminating at the membranous portion in a distinct fourchette. It is easy, when only a superficial examination is made in a male infant so deformed, to mistake the sex.

Treatment consists in a plastic operation according to the necessities of the case.

Stricture of the Urethra.—Strictures of the urethra are of three kinds: 1. Spasmodic; 2. Inflammatory; 3. Or-

ganic. The first two varieties are only temporary, and may be termed obstruction; the third is permanent.

Spasmodic Obstruction is due to spasmodic contraction of the muscular fibres of the urethral canal, especially its deeper parts.

Causes.—Local: Organic stricture, inflammation following suppression of a gonorrhœal discharge, irritation of highly acid urine, etc.—Constitutional: as gout, rheumatism, etc. Foreign matter in the urine, as cantharides, turpentine, alcohol. Voluntary retention of the urine for too long a time. Exposure to wet or cold. Reflected irritation from the anus and rectum, as in hæmorrhoids, fissure, fistula, prolapsus, after operations on the rectum, ascarides, anal prurigo. In the female, reflex irritation from the uterus. Berkeley Hill points out that a frequent cause is a fibrous stricture at or near the meatus. Derangements of the digestive organs and of the cerebro-spinal system, from excess in eating or drinking, venereal excesses and self-abuse, overwork, and worry.

Symptoms.—The attack comes on suddenly. 1. Frequent desire to pass water, but after much straining only a few drops will dribble, and complete retention may ensue. 2. Pain in the perineum. 3. Urine is very acid.

Treatment.—Suppository of opium, or tincture of opium in full doses, or Dover's powder. Warm hip bath, leeches to the perineum, followed by purgatives. If necessary, a flexible catheter (No. 6) should be gently passed, and the water drawn off; this will be much facilitated by the previous injection into the urethra of a solution of cocaine (gr. j to ʒj of water and alcohol). Chloroform will at once relax the spasm.

After-treatment.—Liquor potassæ and hyoscyamus (āā mxx to ʒj), careful diet, warm clothing, and warm baths.

Inflammatory Obstruction is generally associated with the preceding variety, and is due to congestion of the urethral mucous membrane, especially the prostatic and membranous portions.

Causes.—Gonorrhœa, gleet, slight organic stricture in gouty and rheumatic persons whose urine is very acid, also those which produce spasmodic obstruction (*q.v.*).

Symptoms.—1. Intense desire to micturate, with inability to pass water;

if any come away it gives rise to intense scalding, is discharged forcibly, and the stream stops abruptly. 2. The bladder is distended. 3. Pain in the perineum. 4. Urethritis, with a thin purulent discharge. 5. The penis is turgid and erectile, and the mucous membrane readily bleeds. 6. Some pyrexia.

Treatment.—Similar to spasmodic obstruction, with cold or iced water to the penis, or warm poultices.

After-treatment consists in a low diet, liquor potassæ with hyoscyamus, rest in bed, and calomel.

Organic Stricture.—This is a permanent narrowing of the urethra, due to the deposit of lymph in the submucous tissue, attaching this firmly to the mucous membrane, and often extending into the adjacent spongy tissue. The peculiarity of this new tissue is its liability to slowly contract, forming firm cicatricial contractile bands or protuberances.

Forms.—1. Linear, in which a thin membrane stretches across the urethra, and is perforated at its centre or side; when this only partially closes, the urethra assuming the appearance of a narrow band, it is termed a bridle stricture. 2. Annular, ring, or whipcord, where the urethra presents an abrupt constriction surrounding the canal, and looking much as if a piece of string had been tied round it. 3. Ribbon: here the stricture forms a broad band invading the corpus spongiosum for some distance. 4. Irregular or tortuous: here the new product forms hard knots or projections of the mucous membrane, which cause the urethra to deviate from its natural course, and give rise to sudden twists. The stricture may be soft and elastic, or hard, firm, indurated, and cartilaginous, according to the duration of the disease and the amount of formation of new tissue and invasion of adjacent structures.

Number.—Stricture may be solitary or multiple, the former being much the more frequent; a constriction at or near the meatus is rarely single, and the presence of such a stricture should lead the surgeon to search for a deeper one.

Age.—Stricture may occur at any age, but most commonly commences from twenty to forty.

Seat.—Most common at the bulbous

portion of the spongy part of the urethra at its junction with the membranous; next, at the external orifice, and as far as $2\frac{1}{2}$ inches from the meatus; rare in the membranous part, and never in the prostatic except as a result of severe crushes or injury to the pelvis.

Causes.—1. Gleet. This is by far the most common cause by producing long-continued congestion and inflammation of a small piece of the urethral mucous membrane, this being a condition frequently attended with slight ulceration. 2. Mechanical injury to the urethra, especially kicks or blows in the perineum. 3. Cicatrisation of a urethral chancre; syphilis. 4. Congenital in rare cases.

Pathological Effects.—Dilatation of the urethra behind the stricture; inflammation of the bladder (chronic cystitis); dilatation and hypertrophy of the bladder; dilatation of the ureters and pelves of the kidneys; disorganisation of the kidney.

Symptoms arise gradually. 1. Frequent desire to pass urine, particularly at night, with some straining, and a scanty mucopurulent discharge. 2. The stream of urine decreases in size, and is forked, scattered, or twisted. 3. Dribbling of a few drops after the patient has ceased to pass water. 4. Pain at the seat of the stricture during micturition. These symptoms may increase and terminate in complete retention.

Physical Examination.—It is advisable before proceeding to instrumental interference with the urethra to examine the urine. When the above-mentioned symptoms are present in a patient, it is necessary to ascertain by means of instruments: 1. The presence of a stricture; 2. Its size.

1. The presence of a stricture may be known by passing a bullet-headed bougie with a narrow stem, or a well-curved, blunt-ended, flexible English catheter (No. 10 or 11) without a stylet very gently into the urethra. If the instrument will not pass into the bladder, but be stopped, the distance between the point of stoppage and the meatus is to be measured and noted. Should the instrument fairly enter the stricture, it will be tightly grasped.

2. The size of the stricture is next determined by passing instruments in decreasing sizes until one can be intro-

duced without any force into the bladder; the size of the instrument must be noticed. If a bulbous bougie be used, the extent of the stricture is indicated by the shoulder of the bulb meeting with resistance during withdrawal.

Constitutional Symptoms.—Dyspepsia, loss of flesh, pains in the back and loins, rigors, reflex paralysis.

Treatment. — 1. Simple interrupted dilatation. 2. Continuous dilatation. 3. Rupture or divulsion. 4. Internal urethrotomy. 5. External urethrotomy. 6. Combined internal and external urethrotomy. 7. Perineal section. 8. Electrolysis.

1. *Simple Interrupted Dilatation* is always to be tried at first, and consists in the passage of a series of catheters in gradually increasing sizes, at intervals of three or four days. This is the safest method, and does not confine the patient to the house, or prevent him following his ordinary pursuits. Berkeley Hill writes: "The class of cases to which the interrupted gradual dilatation is most suited are early semi-inflammatory strictures, and strictures in the bulbous portion, where the kidneys are much diseased. As a rule, gradual dilatation is useless for bridle strictures, for contraction of the meatus, and for very dense perineal strictures."

To Pass a Catheter.—In the normal urethra there are three points where difficulty may occur: firstly, at the entrance in the roof is the lacuna magna; this is avoided by keeping the instrument on the floor. Next, as the instrument approaches the triangular ligament at the junction of the membranous portion and the bulb, about five or six inches from the meatus; here the instrument must be kept along the roof, and it is advisable to have the instrument well curved. Lastly, in the prostatic portion at the neck of the bladder, and here the point must be directed to the roof.

The patient should lie on his back with the head and shoulders raised, and the knees somewhat elevated, and separated from each other. The surgeon stands on the left side of the patient, and lightly holds the instrument, well oiled, with the thumb and fore and middle fingers of the right hand. Holding the catheter horizontal, with the concavity towards the left groin, the operator

introduces the point, beak downwards, into the meatus, holding the penis with the left hand. He then pushes the catheter onwards, avoiding the lacuna magna, and gently drawing the penis along the instrument with his left hand until four or five inches have been introduced; then the hand is carried to the middle line of the abdomen, and the handle raised and brought forward in the middle line, and then depressed between the thighs. There is a practical point to be remembered, as noticed by Sir James Paget in his Clinical Lectures: "Let me tell you of a symptom which must make you specially cautious if you have to catheterise elderly or old men. If they be passing large quantities of pale urine, of low specific gravity, whether containing a trace of albumen or not, they will be in danger from even the most gentle catheterism."

To dilate the stricture, the operator begins with an instrument which will pass readily through the constriction, e.g. No. 4; passes it into the bladder and withdraws it at once; in three days' time an instrument one size less is used (No. 3), followed by two sizes larger (Nos. 4 and 5); on the next occasion begin with a No. 4, and subsequently use Nos. 5 and 6. The treatment must be continued in this manner until a No. 12 or 14 be reached. To maintain this calibre an instrument must be passed at increasing intervals for some time, and, finally, the patient must never neglect to pass the instrument once a month or six weeks to preserve the size. During this treatment the patient should avoid long walks, and use a nourishing diet, but no alcohol. The urine must be acid, clear, or at any rate free from blood, and not contain much albumen.

Instruments used.—In recent strictures, the flexible French bougie or catheter, with a tapering extremity and a small bulb at the end (bougie or catheter olivaire), is the best instrument. When the stricture is unusually tight, or does not dilate well, a more solid and resisting instrument is required; this is found in the English flexible instruments, which do not bend so readily as the French, and maintain when cold any curve given to them when warm. If the stricture be very hard and resistant, Sir Henry Thompson advises the use of the flexible French bougie, with a short

and very soft lead stylet in its interior, terminating in a fine point which ceases $4\frac{1}{2}$ inches from the end of the bougie; or another plan which is useful is to have the bougie filled with shot. Should a still firmer instrument be required, rigid steel sounds are to be employed, which should be, as recommended by Berkeley Hill, perfectly straight and cylindrical for eight inches from the handle; beyond that the sound should have a curve occupying a quarter of a circle of $2\frac{3}{4}$ inches in diameter—that is, the curve is $1\frac{7}{8}$ inches long, and maintained to the very tip of the sound; the handle is broad and flat.

2. *Continuous Dilatation* is used in cases where there is great difficulty in introducing a catheter, where the stricture does not readily dilate, or the patient is in a hurry to be cured, and in cases of cystitis, after prolonged retention. It is necessary to keep the patient in bed for a week or fortnight. In ordinary cases a flexible gum elastic English catheter or a celluloid instrument is passed, of a size sufficiently small to slip easily through the stricture, and tied in by attaching it to the pubic hairs, or fastening it by soft twine or Berlin wool behind the corona. The end of the catheter should leave the neck of the bladder free. The instrument is replaced in a day or two by one two sizes larger, which is then tied in, and so on. When the full size is reached, an instrument must be passed, at first daily, and then at greater intervals. The disadvantages of this method are that relapses are frequent, and the retention of the catheter in some persons produces great constitutional disturbance, and cannot be endured for sufficient length of time. The urethra is generally dilated to its full size in a few days. Reginald Harrison writes: "It is my practice to have the temperature noted when treating a patient by continuous dilatation; a rapid rise in the temperature indicates that the instrument should be at once withdrawn. Experience has shown me that this is a precaution which should not be neglected. To soothe the restlessness which the restrained position sometimes occasions. I am in the habit of administering morphia in small doses at regular intervals."

Difficult Narrow Strictures.—In these

cases the surgeon will find it advantageous to make his patient rest in bed a few days before treating the stricture, provided there be no retention. A catheter will pass most easily in the early morning after a night's rest, and this should be the time selected. It is surprising to see the ease with which an instrument will often pass when the patient is under the influence of an anæsthetic. Valuable aids are a warm hip bath shortly before catheterisation, an opium suppository, and the injection of a solution of cocaine into the urethra. Having used any of these measures which may be thought desirable, the operator injects the urethra with Lund's oil (almond oil \mathfrak{zjss} , castor oil \mathfrak{zss} , and pure carbolic acid \mathfrak{zj}), with which he also lubricates the instrument, taking care to select a flexible one slightly smaller than the stream; if this pass, it must be tied in. If unsuccessful, a very small silver or steel catheter may be used with the utmost gentleness, directed first along the roof, then on either side, and lastly, along the floor. Should the stricture be twisted and tortuous, very fine flexible bougies (bougies filiformes), made of silkworm gut, catgut, plaited silk, gum elastic, or whalebone, are useful, to the end of which a bend should be given; in using these instruments do not forget that whilst the stricture is at one end, unlimited patience must be at the other. When false passages exist, by keeping to the roof these can often be avoided, and by using a silver catheter, as it can be more easily guided; another plan is to pass filiform bougies into all the false passages, leaving them there until one passes the stricture and is tied in, when the rest are withdrawn. To ensure the entrance of an instrument after the one tied in is removed, these bougies have a small socket at the end, to which a stiff rod can be screwed, and a tunnelled catheter slipped over the guide thus formed; the rod and bougie is taken away, and the catheter tied in: before removing the latter the guide is again introduced through it. Berkeley Hill writes: "A still better plan in very narrow strictures, after repeated failures with the fine bougie, is to pass an endoscope-tube down to the stricture, dilating the anterior portion of the urethra as a preliminary if necessary, and so illuminate the face of the stricture.

The mouth is readily seen, and the filiform bougie, directed by the eye, enters the stricture with surprising facility." A finger in the rectum is often a great assistance.

Accidents which may follow the introduction of an instrument are fainting, shock, urinary fever, hæmorrhage, urethritis, orchitis, false passages, suppression of urine, and abscess of the prostate and perineum.

3. *Rupture, or Divulsion*, is best fitted for tight strictures without much induration. Four principal methods have been used.

(a) *Wakley's Method*.—This consists in passing a small silver catheter as a guide into the bladder, serewing on to this a long steel rod, and passing over it a series of silver tubes of increasing size.

(β) *Holt's Method*.—An instrument ("the dilator") is used, consisting of two grooved blades fixed in a divided handle, and containing between them a wire welded to their points. (This wire is made hollow and fitted with a stylet to allow of the passage of urine, so that the surgeon can be certain he has reached the bladder.) The dilator having been passed into the bladder, a tube of the size of a normal urethra is pushed along the wire, which serves as a guide, traversing the stricture, which it splits. The whole instrument is withdrawn and a full-sized catheter passed. The catheter is passed on alternate days for the first week, and then at gradually increasing intervals.

(γ) *Gross' Method*.—He writes: "Instead of lacerating the tissues with the ordinary form of dilator, I have for several years employed the heavy conical, nickel-plated, steel bougie, which, from its point to its shaft, represents three sizes of the American scale. Six of these bougies are generally put up in a case, and while they effect the desired object equally as well as the dilator, by being rapidly inserted one after another, they are, according to my experience, far superior to it, especially when the stricture is seated in the membranous portion of the urethra." He advises the administration of an anæsthetic.

(δ) *Sir Henry Thompson's Method*.—This distinguished surgeon uses a dilator consisting of two long narrow steel rods accurately applied to each other, forming, when closed, an instrument the size

of Nos. 3, 4, or 5. The rods are joined at each end and along four inches of the shaft. By turning a handle which contains a screw, the rods are separated from each other, forming a spindle-shaped figure, three or four inches in length, and the third or half an inch in diameter. There is an index at the handle to show the amount of distension, which should be up to No. 16 or 18. Before operating, the distance of the stricture from the meatus is ascertained by passing a full-sized bougie; the slide is then placed upon the figure on the stem which denotes the distance. The instrument is passed until the slide reach the meatus, and the blades slowly separated, the screw being turned at intervals of some seconds, and the whole dilatation taking from seven to ten minutes. When the distension is finished the screw is turned back, but only half way, so that the blades shall not be closed, and the instrument is then withdrawn. A full-sized catheter is passed at once and retained for twenty-four hours. On the third day a large metallic sound is passed, and afterwards at longer intervals.

All these methods which tear the fibres of the stricture are apt to produce great constitutional disturbance, and are prone to be followed by a recurrence of the disease. Sir Henry Thompson's method, however, is excellent in strictures of the female urethra.

4. *Internal Urethrotomy* is division of the stricture through the urethra. The cases suitable for this plan of treatment are those where the stricture is situated at the meatus or within the anterior three or four inches of the urethra; in cases of stricture at the bulb of a gristly nature, or which contract quickly after dilatation, cannot be dilated more than a certain amount, and finally, where dilatation produces much constitutional disturbance. Strictures of the meatus or anterior three or four inches of the urethra are treated by passing through the stricture a small sheathed blade, regulated by means of a screw; then by a simple mechanism the blade is projected and the instrument withdrawn, dividing the stricture.

Strictures of the bulb are incised in one or two ways: (a) By cutting from before backwards; (β) By cutting from behind forwards.

(a) *The operation from before backwards.*—This is certainly the best method, as small strictures can be at once divided without previous dilatation, perfect division of the whole constriction can be effected, and the risk of hæmorrhage is less than in the next operation. That distinguished surgeon, Berkeley Hill, who possesses an unrivalled experience with this operation, writes: "The requisites of a urethrotome for cutting from behind backwards are: 1. A guide through the stricture to the bladder; 2. A sharp edge, which, passed along the urethra under a shield, can be protruded by the operator at any part and as deeply as he desires to cut; 3. Means for steadying and tightening the fibres to be divided before the knife is passed across them." The wedge-dilator of the above-named operator is by far the best instrument; it is composed of the following parts: "First, a narrow split sound, calibre of No. 8 of the millimetric scale (No. 2 English), that can be guided through narrow tortuous strictures by being attached to a filiform guide-bougie, previously passed to the bladder. Second, a wedge that runs in dovetail grooves between the halves of the split sound. In this wedge is concealed a knife that can be protruded between the halves of the split sound, when the stricture tissue prevents their separation sufficiently to allow the wedge to pass on. The wedge pushed up to the situation of the stricture, in separating the halves of the split sound, tightens and steadies the stricture thoroughly, while the knife divides it to the width required by the wedge to pass along. If a wedge be chosen that will expand the urethra to its full natural capacity, the cut made by the knife divides the stricture to that extent, but does not pass behind the stricture into the vascular erectile tissue external to it." Berkeley Hill lays great stress on the after-treatment. After incising the stricture, he passes a wedge of the size of No. 27 (millimètres), and withdraws any urine by a No. 24 catheter. No catheter is tied in, but the patient is ordered to retain his urine as long as he comfortably can, which is generally from six to eight hours, by which time the wound is protected by firm clot and plastic fibrin. When the patient desires to urinate he is placed in a warm bath, which can be repeated if

necessary on the next occasion. The temperature must be taken before the patient passes water, and half an hour and an hour afterwards; if there be any elevation, the case is treated for urinary fever. An anæsthetic is always given before operating. The patient must lie in bed for ten days subsequent to the operation, and for the first three days must not get up for any purpose whatever. The bowels are well cleared before the operation, and a purgative, as castor oil, administered on the third or fourth day succeeding. On the eighth or ninth day a bougie, No. 24 or 25 (millimètres), should be gently passed through the stricture. As after all other methods of treating a stricture, the patient will have to be taught to pass a catheter, and employ it at gradually increasing intervals.

Complications.—Hæmorrhage is usually the result of too deep an incision, and may be immediate or after the lapse of a few days; it is controlled by the passage of a hard rubber tube and the pressure of a bandage. Renal congestion, perineal abscess, extravasation of urine, orchitis, epididymitis, nephritis, and septicæmia.

(β) *The operation from behind forwards.*—The stricture must be dilated up to No. 4 or 5 by continuous dilatation. Civiale's instrument is commonly used, consisting of a sound with an oblong bulb at the end as large as a No. 5, containing a small blade, which can be made to project at will. The bulb is passed through the stricture and felt freely movable beyond it, the blade is then made to project and pressed firmly against the floor of the urethra, the stricture being freely divided from behind forwards. The blade is again shut in its sheath and the instrument withdrawn; a full-sized sound is then introduced to see that the stricture has been completely divided. The after-treatment is the same as in the preceding variety.

5. *External Urethrotomy* is division of the stricture by an external incision extending from the skin into the urethra and completely dividing the seat of constriction; this operation is performed in cases where there is considerable cartilaginous induration of some extent and depth, and especially when complicated with perineal fistulæ. When the operation is performed upon a guide passed

through the stricture, it, in this country, bears the name of Syme. In addition to this operation, the urethra is opened in cases in which it is impossible to pass a catheter by "perineal section."

Syme's Operation.—A staff is passed through the stricture. This instrument is made of steel, and varies in size from No. 1 to 6; it is grooved along the convexity, and the lower third is small, the upper being of full size, and forming at its junction with the curved part a prominent shoulder. The staff is to be passed so that this shoulder projects at the upper part of the stricture, then the patient is tied up in the lithotomy position, an assistant holding the staff with his right hand, and drawing up the scrotum with his left. An incision is made *exactly in the middle line* over the stricture, about two inches long, from above downwards, and carried on until the groove can be felt in the staff. The surgeon then takes the staff in his left hand and a sharp straight bistoury in his right, the knife lying upon the forefinger which feels and is fixed against the groove, projects the knife till its point penetrates the urethra one inch from the shoulder of the staff on the bladder side of the stricture, and then with the pulp of the finger behind it cuts upwards and forwards, *through the whole stricture*, until the shoulder be reached. The staff is then pushed on through the stricture to ascertain if this be completely divided, and a concave curved director, with the groove upwards, slipped through the wound along the convexity of the staff towards the bladder. The staff is now withdrawn, and a full-sized catheter passed along the urethra, which guided by the director will easily reach the bladder. The director is now removed, and the catheter tied in and left for forty-eight hours. The after-treatment is the same as for internal urethrotomy. If the stricture be far back a double curved tube should be introduced through the wound into the bladder. Syme laid great stress on the following points: (1) Maintain the median line in the incision; (2) Make a direct opening down to the staff, and not a tortuous one; (3) Divide the whole of the contracted part rather more than less; (4) Do not cut so far backwards as to endanger the deep fascia of the perineum, and use the knife in the deep incision with the cutting edge

upwards; (5) Do not close the end of the inlying catheter, lest urine be forced into or through the wound for want of patency in the instrument; (7) If incisions be made far backwards, introduce a curved tube through the wound when the catheter is withdrawn; (8) Do not neglect dilatation during the process of recovery.

Perineal Section is used in cases in which it is impossible to pass an instrument through the stricture, and as it is very rarely that a filiform bougie cannot be introduced, the operation is but seldom required. Three operations are practicable: (α) Operation from behind; (β) Operation from the front (Wheelhouse's operation); (γ) Operation on the membranous part of the urethra (Cock's operation).

(α) *The operation from behind* is performed thus: A No. 8 silver catheter is passed down to the stricture. The patient is tied up in the lithotomy position on a table in a good light, and the perineum shaved. The operator, sitting in front, pushes a bistoury with the back turned to the rectum into the raphe of the perineum as far as the apex of the prostate, opening the urethra behind the stricture. He then cuts forward through the stricture on to the point of the catheter, and passes this on into the bladder. This is a very difficult and troublesome operation, and cannot be recommended.

(β) *Operation from the front* (Wheelhouse's operation).—The patient being placed as in the previous operation.

Instruments required.—1. A special staff, fully grooved through the greater part, but not through the whole of its extent, the last half inch being "stopped" and terminating in a round button-like end. 2. Scalpel. 3. Two pairs of straight-bladed forceps nibbed at the points. 4. Artery forceps and ligatures. 5. Sponges. 6. A well grooved and finely probe-pointed director. 7. Teale's probe gorget. 8. A straight probe-pointed bistoury. 9. A short silver catheter (Nos. 10 or 11) with elastic tube attached.

(1st Step.) The special grooved staff is passed down to the stricture with the groove facing the perineum, and is held carefully in the middle line in contact with the stricture, by an assistant, who also draws the scrotum upwards. The surgeon then cuts down upon the pe-

rineum in the middle line, beginning opposite the point of reflection of the superficial perineal fascia, and extending to the anterior edge of the sphincter ani, opening the urethra *a quarter of an inch in front of the stricture*, in the groove of the staff and not on its point.

(2nd Step.) The sides of the incision are held widely apart by the straight-bladed nibbed forceps attached to each margin of the healthy urethra in front of the stricture. The staff is withdrawn gently until the button point be visible in the wound; it is then turned round so that the groove looks to the pubes and the button is hooked into the upper angle of the opened urethra to assist in drawing its wall forwards.

(3rd Step.) The interior of the urethra is well sponged, and the mouth of the stricture looked for, through which a grooved and fine probe-pointed director of the smallest size is passed if possible, its groove being downwards; on this director the stricture is safely divided towards the bladder, with a scalpel and probe-pointed bistoury.

(4th Step.) The point of Teale's probe gorget is passed into the groove of the director, and guided by it is directed onwards to the bladder, dilating the stricture and forming a metallic floor to guide a catheter into the bladder, which is then tied in.

(5th Step.) The gorget is withdrawn and the hooked staff and forceps removed, whilst the catheter is left for three or four days. This is an excellent operation.

(γ) *Cock's Operation.*—With the patient in the lithotomy position, the surgeon's forefinger well oiled should be passed into the rectum, the apex of the prostate felt, and the finger maintained there. With the right hand a double-edged scalpel incises the median line of the perineum just in front of the anus, the point of the knife being carried back to open the membranous urethra in the direction of the apex of the prostate. The knife must not be withdrawn until the necessary section of the parts be completed. The lower extremity of the wound comes within half an inch of the anus; a probe-pointed director, guided by the finger, is passed through the wound into the urethra so as to reach the bladder, and along this a catheter is passed and tied in. By this means

a permanent urinary fistula is formed, and the stricture may be afterwards dealt with. Furneaux Jordan in exceptional cases recommends that the membranous urethra, which can be felt with the finger in the rectum between the anal sphincter and the prostate gland, should be opened with a bistoury by cutting through the rectal wall, and a flexible bougie then guided through the stricture from behind forwards.

6. *Combined Internal and External Urethrotomy* is used by Reginald Harrison in cases not admitting of treatment by dilatation, in order to prevent urinary fever, and to allow the wound to heal without being brought in contact with the urine. This operation is especially desirable in cases of dense stricture complicated with chronic cystitis. An internal urethrotomy is performed, then the patient is placed in the lithotomy position, a grooved staff is introduced, and the membranous urethra punctured one inch in front of the anus with a long straight finger-knife, the back being turned to the rectum; the incision is slightly enlarged forwards to admit the index finger. If the staff be not exposed a somewhat blunt but pointed knife is introduced along the finger to the bottom of the wound, and the remaining fibres cut. When the groove of the staff is felt, Teale's small probe-pointed gorget is slid along it, the staff is withdrawn, and a drainage tube passed along the concavity of the gorget. The drainage tube is four or five inches in length, made of gum elastic, and somewhat less in thickness than the index finger. It is secured by an eye on each side, through which a tape is passed, and is fitted with a piece of india-rubber tubing to convey the urine to a receptacle. It should rest *just within* the bladder and no more.

7. *Electrolysis.*—This method of treating strictures has been lately revived. A constant battery of twenty or thirty medium-sized Leclanché cells is used. An electrode bougie connected with the negative pole of the battery is passed down to the stricture, against which it is held, but not pressed, for a quarter to half an hour; the positive pole is placed over the lumbar spine or perineum. The strength of the current varies from one or two milliamperes up to seven, and

is best measured by a galvanometer graduated in milliamperes.

Shock and Fever following Local Irritation of the Urinary Organs.—The introduction of an instrument into the urethra will in some cases produce a fainting fit, followed by convulsions, which pass off in a quarter to half an hour. Rigors also sometimes occur unaccompanied by an elevation of temperature. Severe "shock," with or without suppression of urine, and resulting in speedy death, may supervene. These results are due to disturbance of the spinal cord and medulla oblongata, occasioned by peripheral irritation.

Urinary Fever, arising subsequently to interference with the urinary organs, is classified by Sir Henry Thompson into: 1. The transient attack; 2. The acute recurring form; 3. The continuous form, which may be acute or sub-acute.

1. The transient form arises in any age after puberty, often probably as the result of absorption of a minute quantity of urine, due to epithelial abrasion, as a consequence of a very slight injury to the urethra. It generally occurs in healthy persons with no renal affection. Four or five hours after the use of an instrument, when the urine is passed, there is a rigor, with elevation of temperature, hot and dry skin, followed in a few hours by profuse perspiration and defervescence.

2. The acute recurring form resembles an attack of ague. In this variety the rigors and febrile attacks recur after an interval, followed by a repetition, perhaps four or five altogether. There is generally some slight affection of the kidney, but this may be absent; it may be due to septicæmia, or precede uræmia with suppression of urine and convulsions. In malarious climates it is common.

3. Continuous urinary fever is met with in individuals of middle age or advanced life, who have for some time been suffering from urinary obstruction. In these cases the bladder is hypertrophied and the kidneys affected with chronic interstitial nephritis. There is often no rigor, but the patient feels cold and then warm. The temperature is sometimes increased, sometimes fluctuates from day to day, and at others is below normal. The pulse is quick and thready, tongue red and glazed. An

acute interstitial nephritis is set up, the patient falling into a typhoidal condition which terminates fatally. Reginald Harrison, in his Lettsomian Lecture on this fever, says: "From my observations in connexion with the surgery of these parts, it seems probable that the development of urine fever is really due to the absorption of some such poisonous compound as an alkaloid, which is derived either from urine, or tissue, or wound decomposition, or from all combined, and I would base this conclusion not from any chemical discovery that, so far as I know, has hitherto been made, but from the following deductions, which seem to be warrantable from what I have already stated:—

1. That the presence of urine in relation with a recent wound is necessary for the production of what I have spoken of as urine fever.

2. That mere contact of urine with a wound is not sufficient for its production.

3. That the retention of fresh urine within the area of a recent wound is almost invariably followed by its development in a greater or less degree.

4. That where urine is placed under such circumstances as have been last mentioned, the liability to the development of urine fever is greatly diminished when it is sterilised by local or general means.

5. That the retention of fresh urine, blood, and the debris of damaged tissue in the confines of a recent wound for a certain time, at a temperature of somewhere about 100° Fahr., could hardly be possible without chemical changes taking place in the constituents referred to.

6. That there is a common origin for urine fever is rendered probable by the uniformity of the symptoms attending it, which, though differing in degree, are identical, whether following a surgical operation or an accidental wound.

Sir Andrew Clark has directed attention to the liability of urinary fever to be followed by septic infection, reflex irritation arising and occasioning disturbance of general metabolism, especially in the kidney; then follows septic infection, the septic matter being formed within the body or introduced from without; and lastly, the effect of suddenly drawing off the water from a distended bladder is to remove pressure from the

vessels and produce congestion, which may usher in an acute nephritis.

Prognosis.—If suppression be present the prognosis is very unfavourable. If the fever continue, a gloomy outlook is before the patient.

Treatment.—Reginald Harrison writes: "After a number of trials, I found that as was my drainage so was my freedom from fever." This is no doubt correct, and that surgeon's operation of combined internal and external urethrotomy is the safest. It is important to keep the patient, if possible, before instrumental interference, and for some time afterwards, in a warm room, and administer $\text{m}\nu$ of tr. aconiti immediately after the operation. Another important point is to sterilise the urine by injection into the bladder of some aseptic, and giving quinine by the mouth for two or three days previously. If symptoms arise, wrap the patient up in a blanket, with hot water bottles to his feet, hot tea, full doses of quinine, with carbonate of potash, hyoscyamus and mucilage. Effervescing drinks. If suppression occur, warm baths, or packing in blankets wrung out of hot water. Infusion of digitalis 3j every hour, dry cupping over the kidneys, and subcutaneous injection of pilocarpine.

False Passages.—These are artificial canals which communicate with the urethra, and are generally produced by an instrument being thrust through the lining membrane of the urethra into the surrounding tissue. They are usually situated upon the floor of the urethra at the bulb, the instrument passing through the tissues under the prostate to the right or left of the middle line. The extent varies from a few lines to some inches, the passages terminating in a blind extremity, or opening at its distal extremity into the urethra, rectum, or even the bladder. When the false passage passes into the cellular tissue between the rectum and the bladder, infiltration of urine into the recto-vesical fascia, inflammation, and sloughing will occur. The symptoms when this accident is occasioned are, the instrument is felt to slip suddenly from its position, with a peculiar grating sensation; on the surgeon passing his finger into the rectum, the point of the instrument is plainly perceived through the coats of the bowel, usually on one side of the middle line. (If the instrument be in

the urethra its point is not so clearly felt, owing to the intervention of the prostate, and it occupies the median line.) In addition, the instrument on withdrawal is seen to be covered with blood, and there is free bleeding from the urethra, great pain, and a feeling of laceration.

Treatment.—Arrest hæmorrhage if profuse. If possible, pass a full-sized catheter into the bladder, and leave it there a few days to allow the wound to heal. The treatment for the prevention of urinary fever, previously described, should be carried out. When old false passages exist keep the point of the instrument to the roof and try each side of the urethra, until the best way of avoiding the abnormal opening is discovered. The finger in the rectum is often a great assistance.

Retention of Urine from urethral obstruction.

Causes.—1. Inflammatory swelling. 2. Organic stricture. 3. Enlarged prostate.

1. Retention from inflammatory swelling is generally met with in young and middle-aged persons as the result of a gonorrhœa. The discharge having lessened or ceased, the patient is careless, and exposes himself to cold, over-exertion, or indulges freely in alcohol. On examination per rectum the prostate is found swollen and tender. The urine cannot be passed, though the patient has the most urgent desire to micturate, with constant straining; occasionally a small quantity may be passed in drops, but finally the retention is complete. Rigors, alternating with hot flushes, usher in pyrexia. Pain at the lower part of the abdomen is marked, and often severe. On examination, a pyriform, circumscribed, tender, fluctuating tumour can be detected in the middle line of the abdomen, and this yields a dull note on percussion. If such a case be allowed to proceed unrelieved, the following symptoms appear: A hot skin, feeble and rapid pulse, a dry brown tongue, sense of oppression, headache, urinous odour of the breath and skin, finally hiccough, delirium, and coma; death resulting from the third to the eighth day as the result of uræmic poisoning.

Treatment.—Pass a flexible bulbous French catheter (No. 6), or a coudée very gently into the bladder, the patient being

anæsthetised if necessary. If a flexible catheter will not enter the bladder, a silver one of the same size should be tried, the urethra being previously injected with a solution of cocaine. When the water is drawn off the patient should be freely purged, leeches applied to the perineum, salines and antimony administered by the mouth, opium suppositories by the rectum, and hot sitz baths.

2. *From Organic Stricture.*—Retention is generally due to some excess or exposure in a person who has been passing his water with difficulty for some time. The symptoms are less active than in the inflammatory form.

Treatment.—Ascertain the situation of the stricture, inject cocaine, and then try and pass the smallest flexible catheter, and if successful, tie it in. When this cannot be done, a steel or silver one should be employed. Should this fail, give a warm bath, opium suppositories, rest in bed for a few hours, and then under an anæsthetic renew the attempt. If being no success, the bladder may be tapped with Dieulafoy's aspirator, using a small needle inserted close to the pubes, thus giving temporary relief, and then catheterisation can be again carefully tried. As a last resource, there are three methods available: (a) Cock's operation, when there are signs of abscess or extravasation; (b) Puncture of the bladder through the rectum; (c) Puncture of the bladder above the pubes.

Puncture of the Bladder through the Rectum should always be used unless the prostate be enlarged, owing to the facilities this operation affords for drainage. The bladder is to be pierced in the triangular space which is uncovered by peritoneum, and bounded in front by the prostate and on either side by the vesiculæ seminales and the vasa deferentia. Cock's manner of performing this operation is best. He used a canula $6\frac{1}{2}$ inches long, with a blunt pilot trocar to introduce it into the rectum and apply it at the point selected for puncture; the canula is held in position by the thumb and three outer fingers of the left hand, and the pilot trocar withdrawn. A sharp trocar is then introduced through the canula, and the bladder perforated, the trocar being then removed and the canula pressed well home. Before the bladder is quite emptied a middle and inner tube are inserted into the canula, and the whole

fastened to a band round the waist by tapes passing in front and behind the thighs. Other surgeons place the patient in the lithotomy position, and empty the bowels with an enema, then with the left forefinger inserted into the rectum the posterior border of the prostate is distinctly felt. Along this finger as a guide the trocar and canula are slipped, until the end be in contact with the anterior wall of the rectum, in the middle line, just behind the prostate; the trocar, which has previous to the introduction of the canula been withdrawn within this tube, is then projected, and the instrument pushed firmly into the bladder by depressing the handle, the point being directed in a line towards the umbilicus. An assistant should make firm counter-pressure over the pubes with his hand. The trocar is withdrawn as soon as the bladder is perforated, and the end of the canula retained just within the bladder by means of tapes. After a few days urine may pass by the urethra, or a catheter may be introduced into the bladder. The dangers are, wounding the peritoneum, urinary infiltration, pelvic inflammation and abscess, emphysema.

Puncture above the Pubes is only performed when an enlarged prostate prevents the previous method, or the patient will have to wear a tube for some time. The patient lies on his back, head and shoulders raised, thighs flexed and abducted; by percussion the operator determines the area of dulness, which denotes the bladder rises well above the pubes, and to ensure this is the case a rectal elastic bag dilator should be used. A preliminary incision is made in the middle line just above the pubes, and deepened until the linea alba be reached, the edges of the recti are separated, the peritoneum pushed upwards by the finger, and the bladder being steadied, a curved trocar with the convexity upwards is pushed into it backwards and downwards. The canula is retained in for a day or two, and then a flexible catheter with a shield used instead. It is well to mention here all the causes of retention. (a) Obstructive.—1. Imperforate prepuce or congenital occlusion of urethra. 2. Inflammation of the urethra. 3. Ruptured or contused urethra or bladder. 4. Abscess in the prostate, perineum, penis or vicinity. 5. Calculus. 6. Tumours of the bladder, penis, or urethra. 7. Stric-

ture of the urethra. 8. Hypertrophy and other affections of the prostate. 9. Pelvic tumours. 10. Foreign bodies in the urethra, bladder, or rectum. 11. Ligature round the penis. (b) Reflex Irritation.—Hæmorrhoids, fissure of rectum, worms, etc., operations on the rectum or anus. (c) Nervous.—Disease or injury of the cerebro-spinal axis, hysteria, shock, the influence of certain drugs, as belladonna. The most common causes are, in children, reflex irritation or impacted calculus; in adults, stricture; and in men over fifty, enlarged prostate.

Extravasation of Urine may occur in cases of retention, and is due to the urethral canal giving way at some place behind the stricture, whilst the patient is straining. The locality which yields has usually been thinned by ulceration. The most usual seat of the lesion is a little in front of the triangular ligament, next in membranous part of the urethra between the layers of the triangular ligament. In the latter case urine passes through the anterior layer of the triangular ligament, through the aperture for the urethra, and is forced into the cellular tissue. Owing to the attachment of the deep layer of the superficial fascia, the urine follows a certain course. This layer on the outer side is fixed to the pubic arch of the hip bone, extending as low as the ischial tuberosity and as high as the pubic spine, being attached all along Poupart's ligament to the crest of the ileum; behind, it bends down and joins the free border of the triangular ligament; in front it is unattached, and is continued to the scrotum and the penis. By means of similar connexions on both sides a pouch is formed over the anterior half of the perineum, open in the front. When the urine enters this pouch, as it cannot go backwards or on either side, it escapes forwards into the scrotum and penis, and thence to the abdomen. Owing to the attachment of Poupart's ligament, the urine cannot invade the thighs. When this accident occurs in a child it is generally due to impaction of a calculus in the urethra.

Symptoms.—The patient who has been suffering from retention suddenly feels as if something had given way, and thinks he is making water, but none appears at the meatus; this is followed by temporary relief. Soon pain recurs, the parts become swollen, often im-

mensely so, and pit on pressure. The urine produces acute inflammation, followed by gangrene, with severe constitutional symptoms. The scrotum, perineum, and penis become red, and in a few hours black, boggy, and emphysematous. The patient has all the symptoms of gangrenous fever. The skin and cellular tissue slough, and may expose the testicles quite bare.

Diagnosis.—This has chiefly to be made from erysipelas of the scrotum and penis, and is ascertained by the history of the case, absence of perineal swelling in erysipelas, and the fact that a catheter will easily pass.

Treatment.—The patient is placed in the lithotomy position, a free and deep incision is made in the middle line, extending from behind the lowest part of the perineal swelling to the root of the scrotum, and free incisions three or four inches long in each side of the scrotum, together with smaller incisions in the penis. Reginald Harrison writes: "After incising the scrotum sufficiently to permit the escape of urine from this part, in addition to other incisions that may be required, I am in the habit of squeezing such parts as the scrotum with my hand, just as I would a wet sponge. It is astonishing what a quantity of urine, which would decompose and add to the sloughing, may be thus got rid of." Yeast, chlorinated, or charcoal poultices should afterwards be applied, and the patient should have plenty of prepared oakum packed between the legs.

General Treatment.—This must be very stimulating. Opium, mist. vini gallic., chlorate of potash, ammonia, bark, good liquid diet, and plenty of wine. The parts heal up astonishingly quickly if the treatment be prompt, and the patient's strength be diligently supported.

Urinary Abscess, or Peri-urethral Abscess, may arise from the use of instruments, as a complication of stricture, inflammation of one of the follicles of the urethra, and, in children, more particularly from the impaction of a calculus. An abrasion of the urethral mucous membrane is produced, through which a little urine leaks into the cellular tissue, leading to the exudation of lymph, which thus prevents extravasation; in other cases, the abscess forms external to the urethra, from some adja-

ent irritation, and does not communicate with it at first. The abscess thus formed is generally small and circumscribed, communicates with the floor of the urethra behind the triangular ligament, and comes forward opening externally. Through the openings thus occasioned, urine passes. The most common situation for a urinary abscess to point is the perineum, in the middle line just behind the scrotum, or between the bulb and the anus; the next most frequent place is the scrotum; occasionally it bursts into the urethra or rectum. In cases of gonorrhœa the most usual site is the penis.

Symptoms.—Pain and weight in the perineum, with difficulty in passing water, followed by painful throbbing; the patient is feverish. A hard, brawny, deeply seated swelling may be felt. If one finger be passed into the rectum and another placed over the perineal swelling, fluctuation may be detected. The matter is apt to travel in more than one direction, forming fistulæ, which do not give free exit to the pus and urine, and thus originate septicæmia or some form of urinary fever.

Treatment.—A free incision should be made at once in the middle line of the perineum, and poultices should be applied. The cause must be ascertained and remedied.

Urinary Fistula results from urinary abscess, sloughing from extravasation of urine, mechanical injury, ulceration, etc.; it is commonly associated with stricture. Occasionally it arises from impaction of foreign bodies, wounds, and the bursting of an abscess into the urethra. Fistulæ are most commonly met with communicating with the bulbous part of the urethra, and having their external opening in the perineum, scrotum, or sheath of the penis; very rarely they open in the groin, upper part of the thigh, above the pubes, in the gluteal region, or in the rectum. If situated in front of the scrotum the fistula is, as a rule, single; when occupying the perineum, multiplicity is the usual event. The aperture is seldom larger than a pin's head, unless there has been much sloughing. The amount of urine which passes through the fistula varies from a few drops to a large amount. They are commonly twisted, long and narrow, and become lined by a mucous membrane. Occa-

sionally the fistula contains a calculus, formed by phosphatic deposit from the urine. I have seen a stone as large as a hen's egg removed from a long-standing fistula arising from laceration of the urethra. In many cases the perineum is greatly indurated, hard, and brawny; the surrounding parts being much enlarged.

Treatment.—When the fistula results from stricture, and is unaccompanied by much induration, restoring the natural size of the urethra by catheterisation, internal urethrotomy or dilatation will cure the fistula. If there be much induration, the patient must be taught to pass a catheter and draw off his water whenever he desires to micturate; the urine must always also be drawn off previous to defæcation. Reginald Harrison writes: "If dilatation of the stricture be not sufficient to bring about closure of the fistula, I recommend an expedient I first saw practised by Dr. Gorrey in New York, and which I have on more than one occasion successfully advised, that is, I direct the patient on every occasion he micturates to close up the orifice of the fistula with his finger, and to be careful, by the exertion of a sufficient amount of pressure, to prevent the escape of a single drop of urine by the false route." As local applications, tr. cantharides, sulphate of zinc, sulphate of copper, or nitrate of silver injected in solution into the fistula; passing a probe coated with nitrate of silver. Laying open the fistula, and making it granulate from the bottom. Galvanic cautery. When the parts are much indurated, and the fistulæ numerous, perineal section by Syme's or Wheelhouse's method is necessary.

Ante-scrotal Fistulæ, in which there is loss of substance, must be treated, either by urethroraphy, paring the sides of the fistula and bringing them together in the middle line; or urethroplasty, by transferring a flap of skin to remedy the loss of substance. In these operations it has been recommended to puncture the bladder per rectum, to prevent the urine flowing over the wound.

Diseases of the Penis.

Phimosis consists in the prepuce being abnormally long, with a small opening, so that it cannot be drawn back to expose the glans. It may be congenital, or accidental. In the congenital form the

disease depends chiefly upon shortness and want of development of the mucous membrane, the skin and cellular tissue being abundant; it often occasions much local irritation, from retention of the glandular secretion, and may give rise to masturbation; balanitis; difficulty in micturition, with symptoms resembling stone in the bladder, in extreme cases the urine distending the prepuce like a bladder or "balloon"; incontinence of urine, with irritability of the bladder; adhesions between the glans and the prepuce (adherent prepuce); calculi between the glans and the prepuce; reflex paralysis, and nervous affections, as epilepsy and chorea; atrophy of the glans; from the straining efforts required in passing water, hernia or prolapsus recti may be produced. In after life, if not remedied, it aggravates any venereal disease, and prevents proper treatment, and also is a predisposing cause of epithelioma of the penis, and may prevent sexual intercourse or conception. The accidental or acquired form arises from inflammatory swelling of the prepuce, due to balanitis, chancres, gonorrhœa, herpes, etc.

Treatment.—In the accidental form, rest, warm fomentations, a saline purge, and the repeated injections of tepid or cold astringent lotions, as sulphate of zinc and tincture of opium, together with the treatment of the venereal disease, may induce the phimosis to disappear; if not, it is necessary to operate.

Operations.—(α) Dorsal incision. (β) Lateral incisions. (γ) Circumcision. (δ) Dilatation.

(α) *Dorsal Incision.*—The point of a director is pushed in front between the glans and the prepuce, along this a curved sharp-pointed bistoury is guided, and made to transfix the prepuce, about half an inch up; this is then divided from within outwards, up to its orifice. The incision in the mucous membrane will not be as long as that in the skin, and should be lengthened with scissors; the edges are stitched to the margins of the skin wound by five or six silk sutures. Instead of a knife, scissors may be used, having one blade probe-pointed; this is slipped under the prepuce, the other blade being outside, and the incision thus made. Any redundant skin can be removed by the scissors, and the angles rounded off. This method is used to expose chancres and warts. If a soft

chancre be present, a solution of nitrate of silver (gr. xl to ʒj) should first be injected under the prepuce, followed by the injection of a saturated solution of common salt, to remove excess of the caustic: by this means the albumen is coagulated and the sores covered. The operation is then performed, and the edges of the incision touched with nitric acid to prevent inoculation.

(β) *Lateral Incision* (Furneaux Jordan) is used for congenital phimosis in adults. "The prepuce, first on one side and then the other, is divided, skin and lining, by probe-pointed scissors, to the extent of a quarter of an inch. The prepuce is then partially retracted, exposing on both sides a quadrilateral space of lining membrane, which is divided by a second snip on each side. The prepuce may then be fully retracted, and the incisions which were made parallel with the long axis of the penis will be found to have assumed a linear shape, at right angles to the line in which they were made. Usually no stitches are needed; all that is required is that the prepuce be kept well retracted by a strip of greased or wet lint."

(γ) *Circumcision.*—Instruments required: 1. Small straight bistoury, or probe-pointed scissors; 2. Polypus forceps; 3. Director; 4. Probe; 5. Half-inch wide tape; 6. Artery and torsion forceps; 7. Fine ligatures; 8. Silk sutures; 9. Lint; 10. Ice; 11. Anæsthetic and inhaler.

A probe is first passed underneath the prepuce to ascertain that no adhesions are present between it and the glans, and if they do exist, to tear them through. The prepuce is drawn forwards and grasped by an assistant with the blades of a polypus forceps, just in front of the glans. With one sweep of a bistoury the prepuce is cut off in front of the forceps. The mucous membrane is now seen covering the glans, and must be slit up as far as the corona, on the dorsal aspect; this may be effected by the use of a bistoury, guided by a director, care being taken not to pass the director into the meatus, or with probe-pointed scissors; the membrane is then separated from the glans with the thumbs. If necessary, the skin may be divided along the dorsum for half an inch from the cut surfaces. Any small arteries bleeding should be twisted or tied, and the mucous

membrane and skin united by five or six silk sutures. Cold applications are applied for forty-eight hours. Adhesions between the glans and prepuce must be broken down by the thumb-nail, or dissected through. If broad adhesions exist, all the mucous membrane should be removed, except a ring one-eighth of an inch wide, next the corona; the skin having been freed from the subjacent tissue, is stitched to this ring, leaving the glans quite bare. Care must be taken that the forceps protect the glans, as this has been wounded in making the section of the prepuce. If the prepuce be very œdematous and swollen, it is well to slit it up first with a probe-pointed bistoury, and complete the circumcision with a pair of scissors (Harrison). If too much skin be removed, the cicatrix may exercise so much pressure on the under surface of the urethra as to impede micturition. When the frænum is very tight in the relaxed condition of the parts, it should be divided, and the artery twisted or ligatured. After circumcision, the patient should rest quietly for a week or ten days, as otherwise the parts are apt to remain œdematous and inflamed, particularly about the frænum. To remove the first dressing, it is well to have the patient in a bath, to soak the dressings for some time. Circumcision is the best operation in children and in adults, when the skin is redundant.

(δ) *Dilatation* is performed by introducing a pair of forceps under the mucous membrane of the prepuce, and opening them widely, or in adults, by a urethral dilator. It is not to be recommended except when the patient will not submit to a cutting operation, or is known to suffer from the hæmorrhagic diathesis.

Paraphimosis occurs when a prepuce with a narrow orifice is drawn behind the glans penis, and cannot be replaced forward, producing strangulation behind the corona. It occurs most frequently in boys, but is met with in adults during sexual intercourse, and accompanying venereal disorders. The compression it occasions produces œdematous swelling, and if unrelieved, ends in ulceration or sloughing. The appearances presented in a case are, first the glans penis swollen and congested; behind this a circular swelling of swollen mucous membrane,

which is really the everted mucous lining of the preputial orifice; behind the latter, at the bottom of a deep groove, is the seat of stricture, consisting of the skin of the prepuce (at its point of junction with the mucous membrane), and posterior to this groove are the swollen integuments of the penis.

Treatment.—The foreskin must be drawn forwards to its normal position; to aid this, ice, or ice cold water may be applied to the parts; or a narrow elastic bandage made to encircle the glans, over wet lint, for a short time; or the parts may be punctured with a needle, if they be distended with serum; or when the paraphimosis is of some days' standing, strapping the glans firmly with strips of plaster will facilitate reduction. Then the glans is well oiled, and compressed with the operator's thumbs, backwards, whilst the prepuce is drawn forwards at the same time by the index and middle fingers of both hands interlocked. This procedure is very painful, and an anæsthetic may be necessary. Should this measure fail, which is rarely the case, after the patient is anæsthetised, an incision is made on the dorsum, one-third of an inch in length, with a narrow-bladed scalpel, on each side of the middle line, cutting through the stricture at the bottom of the groove. Then reduction is accomplished, provided there be no inflammatory adhesions; if these be present the parts must be left unreduced, and cold lead lotions applied.

Cancer of the Penis is usually epithelioma; as a rare event scirrhus may be met with.

Causes.—Phimosis predisposes to this affection, which is but seldom seen in a Jew. It is most frequent after forty-five. Venereal disease may occasion epithelioma: (1) By producing warts; (2) By the production of chancres; (3) By the scar of a chancre; (4) By tertiary induration. Injuries of the penis may precede the onset of this disease.

Symptoms.—Epithelioma commences usually upon the glans or inner surface of the prepuce as a warty growth, with a hard broad base, and at first painless; after a time this becomes abraded, bleeds, and ulcerates, discharging a serous foetid discharge, and occasioning lancinating pain. Another way the disease originates is a flat tubercle, the surface of which soon cracks. Ulceration pro-

gresses rapidly, with destruction of the neighbouring parts, destroying the penis and invading the scrotum. The ulcer has hard, raised, and everted edges, the base is unequal in depth, greyish in colour, and uneven or warty, with wide induration round it. The inguinal glands soon become involved, especially if the glans or inner surface of the prepuce be the seat of the disease.

Diagnosis.—Stony hardness; early onset of ulceration; hard, ragged, warty, and everted edges of the ulcer; unequal, uneven, indurated base; tendency to bleed at the slightest touch; offensive discharge; distinct enlargement of the inguinal glands; great pain; failure to improve under treatment; and the patient having passed middle age, point to epithelioma, and distinguish it from warts or syphilitic induration.

Treatment.—Early removal of the part affected affords the only chance, together with all enlarged glands.

Amputation of the Penis.—(α) By a single sweep with the knife. (β) Ricord's method. (γ) Teale's method. (δ) Hilton's method. (ε) Total extirpation, including the attachments of the crura.

Instruments Required.—1. Tape or Clover's tourniquet. 2. Straight bistoury. 3. Scalpel. 4. Artery and torsion forceps. 5. Dissecting forceps. 6. Scissors. 7. Ligatures. 8. Sutures. 9. Flexible catheter. 10. Lint. 11. Icc. 12. Anæsthetic and inhaler.

(α) A narrow tape or Clover's tourniquet is used to restrain bleeding. The penis is put on the stretch, the skin being drawn a little forward, and the organ separated by a single sweep of the knife. Five arteries will require deligation, the two dorsal, one in each corpus cavernosum, and one in the septum. The écraseur, or galvanic écraseur, is sometimes used instead of the knife, but possesses no advantages, and leaves an ill-looking wound. Stricture of the orifice of the urethra is apt to result.

(β) *Ricord's Method* is an improvement on the preceding, and consists, after amputation, in slitting the urethra with scissors in four places, so as to make four equal flaps, and then stitching with catgut or fine silk sutures to the skin. The contraction of the cicatrix tends to open instead of closing the urethra.

(γ) *Teale's Method* is a similar proceeding to Ricord's, the urethra being slit

together with the skin covering it, by a bistoury guided on a director for two-thirds of an inch. The skin and mucous membrane are stitched together so as to form an oval orifice.

(δ) *Hilton's Method.*—Introduce, if possible, a No. 12 elastic catheter to define the corpus spongiosum. The skin is drawn towards the pubes by an assistant, the corpus spongiosum clearly defined, and at the seat of amputation the surgeon transfixes with a narrow-bladed scalpel so as to separate the corpus spongiosum from the corpora cavernosa. The edge of the scalpel is then turned up and the corpora cavernosa divided: after the section these are dissected forwards off the corpus spongiosum for a quarter of an inch, the catheter is then withdrawn, and the amputation completed. The vessels having been secured, the projecting part of the corpus spongiosum is slit up longitudinally, so as to form two or three flaps, and the skin and mucous membrane stitched together.

Modification.—An anterior skin flap may be first formed, then the corpus spongiosum separated from the corpora cavernosa, and a posterior skin flap made, from which the urethra is dissected out. The corpora cavernosa are divided directly upwards at the level of the point of transfixion. The upper flap is punctured at a point opposite the urethra, and the corpus spongiosum drawn through the face of the flap, slit up and stitched. The upper and lower flaps are joined by sutures.

(ε) *Total Extirpation, including the attachments of the Crura.*—With the patient in the lithotomy position, a vertical incision is made through the mons veneris, and carried down each side of the root of the penis into the raphe of the scrotum, which it completely divides. The skin is well retracted and the body of the penis drawn fully out of the wound. The halves of the scrotum are separated by the finger down to the corpus spongiosum. A sound is passed along the urethra to serve as a guide for the passage of the knife between the corpus spongiosum and the corpora cavernosa, which are separated. The sound is withdrawn and the corpus spongiosum cut through; the urethra is then separated by careful dissection from the adjacent structures, as far back as the

triangular ligament. The corpora cavernosa are detached from the pubic arch by cutting the suspensory ligaments and using a periosteal elevator. The urethra is opened on its under surface for half an inch, and stitched to the skin at the hinder end of the scrotal incision. The rest of the wound is closed by sutures, and a drainage tube inserted. This operation, which was proposed by Pearee Gould, is the best means of effecting a radical removal of the diseased organ, and at the same time prevents infiltration of urine. The wound must be kept very clean with antiseptics, as blood-poisoning readily occurs in so vascular a part.

Diseases of the Scrotum.—Epithelioma, or chimney sweep's cancer, principally occurs in chimney sweeps above middle age, and is due to the irritation caused by the soot. It begins usually at the

lower and fore part of the scrotum as a small tubercle or wart of a leaden colour, which cracks, becomes indurated and ulcerates. The ulcer discharges a thin bloody fluid, has a sinuous edge, with hard everted margin, and an uneven, indurated base. It rapidly implicates at last the greater part of the scrotum, and exposes the testicles. The inguinal and pelvic glands become enlarged, and ulceration may ensue, with the formation of cancerous ulcers. Death results from the constant discharge and pain within four or five years.

Treatment.—Excision or extirpation by caustics; if the glands of the groin be much affected they must be removed.

Elephantiasis, or Hypertrophy of the Scrotum, is very rare.

Fibrous, fatty, and cystic tumours have been met with in this region.

CHAPTER XXXV.

DISEASES OF THE TESTIS AND CORD.

Malposition of the Testis.—In the fœtus the testicles are contained in the abdominal cavity, but descend to the scrotum shortly before birth, but in some instances this normal descent does not occur; one or both may remain in the abdomen or inguinal canals, and only descend a few months or a year after birth. Such a condition may depend on intra-uterine peritonitis producing adhesions or fusion of the two testicles (synorchism), on contraction of the abdominal rings, or an imperfect development of the gubernaculum testis. Not infrequently they do not descend until the thirteenth or seventeenth years, and more rarely this is delayed until the age of twenty-one. In about one case in a thousand, one testicle is retained permanently, such persons being termed *monorchides*; in one in ten thousand both testicles are retained, such persons being named *cryptorchides*. The retained testicle is often atrophied, or imperfectly formed, and in cryptorchides there may be impotence in consequence, though this does not necessarily result, for in some cases spermatozoa are present in the semen. When the testis is

in the inguinal canal it may become inflamed as the result of gonorrhœa or traumatic violence; it may be attacked by malignant disease; complicated with hernia or hydrocele; it has been mistaken for a bubo.

In rare cases the testicle in its descent misses the scrotum, and lodges itself in a pouch in the perineum (ectopia perinealis); here, if inflamed, it may be mistaken for a perineal abscess. In other cases the testicle descends like a femoral hernia through the crural ring, and is found on the upper and inner part of the thigh (ectopia cruralis). The testicle may sometimes be retroverted, having the vas deferens and epididymis in front, and the body of the testis directed backwards; in another group of cases reversion may be present, the testicle being upside down, with the globus major at the bottom of the scrotum, and the vas deferens arising from the top of the testis.

Treatment.—As a rule, all that can be done is to protect the testicle with a suitable truss. When the scrotum is of sufficient size in children or young adults,

the testicle, under aseptic precautions, may be cut down or brought into the scrotum and fixed by catgut sutures.

Inflammation of the Testis.—When the body of the testicle is inflamed, this is termed *orchitis*; when the epididymis is the part affected, *epididymitis*: the latter is the more common.

Causes.—Traumatic injury, gonorrhœa, gout, rheumatism, metastasis. Any irritation of the urethra due to the use of instruments, or the passage of calculi through the urethra, stricture of the urethra, gonorrhœa, and smallpox, usually occasion epididymitis. When the inflammation is due to mechanical injury, as a squeeze or blow, or occurs in persons suffering from mumps, in rheumatic or gouty persons, or in malaria and typhoid fever, an orchitis generally follows. Both glands may be attacked successively or simultaneously, but when the result of a gonorrhœa the rule is that only one epididymis is affected.

Symptoms.—These vary according to the part implicated. If the epididymis be attacked the inferior globus is enlarged, hard, and tender; the whole of the epididymis soon becomes involved, forming a crescentic mass at the back of the testicle. The cord is more or less swollen and tender on pressure; and there is often a good deal of effusion into the tunica vaginalis, the fluid containing fibrinous material and coagulating on removal, this being termed *acute hydrocele*, and resulting from inflammation of the tunica vaginalis. The pain is severe, dull, heavy, and sickening, felt in the scrotum, groin, iliac region, and loins; there are great tenderness and a heavy dragging feeling. The general symptoms are sharp fever, constipation, sickness, and vomiting. The scrotum is often red, shining, tense, with its superficial veins enlarged; in some cases the skin is œdematous. Verneuil has pointed out the fact that inflammation of the testicle is often associated with inflammation of the throat. An epididymitis frequently gives rise secondarily to an orchitis. When the body of the testicle is alone attacked it forms an ovoid swelling, tense, hard, and exquisitely painful. The pain and constitutional disturbance are generally much greater than in epididymitis. The inflammation reaches its height in seven or eight days, and at the end of three weeks has generally dis-

appeared; suppuration is of rare occurrence. If the inflammation persist for some time, the tubes become thickened, and at parts dilated, and may be quite obstructed, producing, if both testicles be affected, sterility; after epididymitis, the lower end of the globus minor may be obliterated and converted into a hard mass of dense fibro-cellular tissue, which totally prevents the passage of spermatozoa, although the power of erection, sexual appetite, and ability to emit sterile seminal fluid, remain. As the result of orchitis, atrophy of the testicle sometimes is met with.

If the testicle be in the inguinal canal and become inflamed it is likely to simulate strangulated hernia. The symptoms are a large, hard, irregular tumour in the groin; at some parts soft and tender, and causing a sickening sensation when squeezed, vomiting, constipation, and colicky pains; the testis is absent from the scrotum on the corresponding side, and the bowels can be relieved by purgatives. There is much danger of peritonitis or sloughing occurring.

Treatment.—Rest in bed with the testicle supported by a handkerchief or broad piece of strapping. Leeches along the cord, or opening the scrotal veins if distended. When the patient is young and healthy, cold by the icebag, evaporation of ether, or, better, ice-cold water applied by the irrigation coil; if more agreeable to the patient, warm poppy fomentations and belladonna and glycerine smeared over the part, or tobacco and linseed poultices. Hot applications must always be used after the first twenty-four hours, in metastatic cases, in the old and feeble, and when the skin is much inflamed. Furneaux Jordan recommends painting the scrotum with a solution of nitrate of silver, and iodine liniment painted over the course of the femorals. If the pain be severe, or there be much effusion, puncture of the testicle and tunica vaginalis with a trocar or narrow knife will afford great relief; another application which is of service is the injection of an atropo-morphia solution into the sac. The patient must be kept on a spoon diet, and a good dose of calomel should be taken. Salines, as liq. ammon. acet. and pot. nit. or pot. tart., with antimony and large doses of hyoscyamus, must be given. Brunton recommends pulsatilla.

If an abscess form it must be opened and drained with catgut or a drainage tube; when gangrene of the scrotum is threatening incisions must be made to relieve tension. In subacute forms, Dover's powder and calomel are most trustworthy. Later on, to produce absorption, strapping the testicle, iodide of potassium, or perchloride of mercury, in small doses by the mouth; oleate of mercury or iodine and mercurial ointments locally, together with the application of the constant galvanic current. Painting with nitrate of silver or contractile collodion over the scrotum is sometimes of use. In protracted epididymitis always examine the urethra for stricture.

Hydrocele of the tunica vaginalis consists in an accumulation of serous fluid in the cavity of the tunica vaginalis; it is usually single, but may be double.

Characters of the Fluid.—The fluid is generally clear, of a straw or amber colour, specific gravity 1025, slightly alkaline; it contains fibrinogen and albumen, and is coagulable by heat. In elderly persons it may be of a dark brown or chocolate colour, from mixture with blood, and may contain particles of cholesterine; occasionally it may present a milky appearance, from the presence of fat, but this is rare. The quantity varies from six to twenty ounces or more.

Causes are obscure; it is often referred to blows or other irritation, as straining in stricture of the urethra, relaxation of the scrotum from intense and protracted heat in hot countries, malarial poison. It is most frequently met with in persons about middle age, of feeble power, or in the cachectic and gouty, and is due to hypersecretion or obstruction of the lymphatics. It is frequently conjoined with syphilitic sarcocele, or sarcoma of the testis, and sometimes with chronic visceral disease. In young infants it is not uncommon, and may be the ordinary acquired form, but is generally due to the persistence of a tubular communication between the cavities of the tunica vaginalis and peritoneum; this form is termed congenital, and may be recognised by the fluid returning into the abdomen on raising or pressing the tumour.

Symptoms.—A smooth and uniform

swelling, covered by healthy skin, at first soft and then hard, of a pyramidal shape, with the large end downwards. It reaches upwards along the cord towards the external abdominal ring. The cord can be distinctly felt, free and healthy, above the upper margin of the tumour. The swelling is elastic, and fluctuates when pressed between the fingers alternately; it is not painful except at the lower and back part, where the testicle is situated. As the hydrocele increases and attains large dimensions, the skin of the penis is taken up by the swelling, and the penis becomes lost in the scrotum, the glans being seen at the bottom of a navel-like depression. In size it varies from a hen's egg to a coconut, and it occasions a feeling of weight and dragging. The best diagnostic sign is the translucency of the swelling; this is ascertained by grasping the tumour so as to push the swelling to the front of the scrotum and make the skin tense over it, a candle is held on one side, the surgeon looking through the hydrocele from the opposite side and placing the edge of his hand along the most prominent part of the swelling; if translucent a reddish glare is seen. In doubtful cases, looking at the tumour through a stethoscope, and having the room darkened, are auxiliary measures. If the sac be thickened or the fluid turbid, no translucency can be detected. The testicle is usually at the lower and back part of the hydrocele; but as the result of adhesions, or in those rare cases of retroversion of the testicle, it may lie in front; in one case treated by me the testicle was at the upper and fore part of the scrotum. The sac is usually thin, but in some old cases is much thickened and even cartilaginous or osseous; it may be divided into compartments by bands, is occasionally bilocular, the cavity being partitioned into two sacs, and may contain loose bodies. When the quantity of fluid is very great, atrophy of the testicle may ensue as the result of pressure.

Coverings are the same as those of the testis, skin, dartos, spermatic fascia, cremaster, fascia propria.

Diagnosis.—If translucent, the swelling must be a hydrocele. If not translucent, to distinguish it from a hernia the history must be considered; the latter begins above and descends, the

former below and ascends. Ascertain if the swelling can be diminished on the patient lying down. Hydrocele, when once formed, is a permanent enlargement, not influenced by position. In hernia the testicle can usually be felt, but not in hydrocele; and in the latter the cord and inguinal canal are free. Hernia may however co-exist with hydrocele, and the hernia may communicate an impulse to the hydrocele on coughing; the diagnosis is best made when the patient is recumbent. To diagnose a non-translucent hydrocele from a hæmatocele, cystic, or other tumour of the testis is often impossible without an incision. In all doubtful cases cut cautiously down under aseptic precautions and examine.

Treatment is: (a) Palliative, and (β) Curative.

(a) *Palliative* consists in tapping the hydrocele and using a suspensory bandage. In infants use acupuncture with a needle or hare-lip pin, apply evaporating lotions, or paint the scrotum with tr. iodi., and if there be a communication with the peritoneum, direct a truss to be worn.

Tapping a Hydrocele.—The position of the testicle is ascertained by transmitted light, or by the sensations communicated to the patient on pressure; the tumour is grasped in the surgeon's left hand in such a manner that the skin is stretched tightly over the front of it. A small trocar and well-fitting canula, well greased with carbolic oil, is then, with a quick and vigorous plunge, pushed through the skin in front (at a spot about one-third of the length of the tumour from the bottom) in an upward and backward direction. Care must be taken to avoid the scrotal veins and to regulate the depth the trocar enters by placing the finger along its side. As soon as no resistance is felt and the end of the trocar can be freely moved, it is withdrawn, and at the same time the canula is pushed on to its hilt, the fluid is then withdrawn, the surgeon the while maintaining the tension of the hydrocele. The canula is withdrawn when the stream ceases, and it is usual to apply plaster or collodion to the puncture, but this is quite unnecessary, and I invariably leave the wound uncovered. In some cases tapping will effect a cure, and in old persons, or those who are feeble and un-

healthy, it is the only plan admissible. The surgeon should not be in too great a hurry to repeat the operation, as it is often some months before all the benefit expected ensues.

Accidents which may follow tapping are: 1. Erysipelas; 2. Suppuration of the sac; 3. Sloughing of the scrotum; 4. Hæmatocele. If suppuration of the sac occur, a free incision is to be made into the anterior and lower part of the scrotum, the contents washed out, and a drainage tube passed through the incision and out of a counter-opening on the opposite side; iodoform is used as a dressing.

(β) *The Curative Treatment* is performed by: 1. Injection; 2. Seton; 3. Incision; 4. Electrolysis.

1. *Injection* is the most commonly used. Solutions employed are port wine; sulphate of zinc (ʒj to ʒxij); warm water; carbolic acid ʒj with glycerine ʒj; or best of all, tincture of iodine. The syringe should have a platinum nozzle; if a silver instrument be used it must be immediately washed with a solution of hyposulphite of soda (ʒj to ʒj), to prevent the action of the iodine on the silver. This solution will also remove iodine stains from the hands (Curling). After the fluid is drawn off as previously described, a suitable syringe, containing ʒj or ʒij or more of tr. iodi., according to the amount of fluid withdrawn, is fitted to the canula and injected into the sac; the canula is removed and the injection worked about, so that every portion of the inner wall of the sac may come in contact with it. Some surgeons allow the injection to escape through the canula; others, with whom I agree, prefer to let it remain in the sac. Large hydroceles must be first reduced in size by one or more tapplings. Care must be taken to inject the fluid well into the sac, and not into the cellular tissue of the scrotum; if this accident occur, free incisions must be at once made into the scrotum at the seat of infiltration. Instead of iodine, iodoform in fine powder has been blown into the empty sac with satisfactory results.

Injection produces pain extending up the cord to the abdomen, and may occasion faintness; it is followed by redness, and slight tenderness of the scrotum, with some pyrexia and moderate effusion of fluid. Of late, after the fluid is drawn

off, I have injected a solution of cocaine (cocaine grs. vj, boracic acid gr. xx, water 3j), allowed it to remain for ten minutes, then let it flow off, and replaced it with the iodine solution; this renders the operation painless. The after-treatment consists in keeping the patient in bed for a day or two, and if necessary applying evaporating lotions, or hot belladonna fomentations; several weeks generally pass before the swelling completely disappears.

2. *Seton*.—This is used when the iodine injection fails, from insufficient inflammatory action being set up to excite absorption. The seton used is composed of two or three threads of dentist's silk, moistened, if thought necessary, by tr. iodi.; it is introduced through the canula by a needle six inches long, which is made to pierce the anterior and upper part of the scrotum: the needle and canula are removed, and the ends of the thread tied loosely together. The seton is left in from twenty-four to thirty hours, or until the scrotum be quite hard and at least a quarter the size it was before the operation. The after-treatment is the same as that after injection.

3. *Incision under aseptic precautions* is used in very old hydroceles with thick rigid walls; where the diagnosis is uncertain; when injection has failed; in cases of congenital hydrocele not benefited by a truss; when two hydroceles co-exist, and when a hydrocele is complicated with a hernia. The pubes and scrotum are shaved on the affected side, a longitudinal incision is made along the front of the scrotum at its lower and anterior part, extending through the skin; all hæmorrhage is arrested, and the sac is then opened at the upper end of the wound, the incision being prolonged with a probe-pointed bistoury, guided by a director or the fingers, to the same extent as the skin wound. A drainage tube is inserted, and one or two sutures of carbolised catgut or silk used to unite the tunica vaginalis and the skin. The usual dressings are applied, perforated for the passage of the penis, and fastened with a spica bandage. The dressings are changed every four days. Some orchitis generally ensues, but the patient is, as a rule, up in a week.

4. *Electrolysis* is very useful in recent

hydroceles. A solution of cocaine should be injected into the sac with a hypodermic syringe. Two needles, respectively connected with the negative and positive poles of a constant galvanic battery, are inserted into the sac, and a current (measured by an intensity galvanometer) of from five to ten milliamperes is maintained for ten to forty minutes.

Encysted Hydrocele.—Cysts connected with the testicle are divided into large and small. The latter are found in 50 per cent. of persons who have passed the age of forty; they are situated beneath the serous coat of the epididymis, and more rarely beneath the tunica vaginalis of the testis. In size they equal a pea, and are composed of a proper fibrous envelope containing a clear fluid with epithelial scales and small crystals, but no spermatozoa. They may be single or multiple, are sometimes pedunculated, and sometimes burst. The irritation produced by them may give rise to an ordinary hydrocele, but as a rule they produce no symptoms and require no treatment.

The *large* cysts are less common than the small, and it is these that occasion encysted hydrocele. They may attain a large size, even containing twenty to forty ounces of fluid; the fluid is contained in an adventitious sac, quite distinct from the tunica vaginalis, formed of a fibrous investment lined by tessellated epithelium. As regards the origin of these cysts they are usually due to obstruction and dilatation of one of the vasa efferentia; in some cases due to enlargement of one of the small cysts; in others the result of dilatation of foetal remnants, either the organ of Geraldès, duct of Müller, or vas aberrans of Haller; lastly, they may be formed by dilatation of a lymph space in the connective tissue. The usual form is found in or near the epididymis, especially its head (encysted hydrocele of the epididymis), pushes the serous investment of the gland before it, and spreads out the seminal ducts over its periphery. Two rare varieties occur: 1. Formation of a cyst between the tunica albuginea and the tunica vaginalis; 2. Formation of a cyst within the tunica albuginea itself, distending this into a cavity enclosing the cyst (encysted hydrocele of the tunica albuginea).

Contents.—The fluid may be milky white, and when examined microscopically will show spermatozoa; the presence of spermatozoa is due to the cyst being connected with the spermatic tubes, and from this reason the name *spermatocele* is sometimes applied to the tumour. In a second group of cases the fluid is clear like water, containing chloride of sodium and alkaline carbonates, but *no spermatozoa and no albumen*.

Symptoms.—This disease is most common in boys and young adults. It forms a light, fluctuating, globular, translucent swelling; very movable in the scrotum; smaller and more irregular in shape than the ordinary hydrocele; and situated above, below, or to one side of the testicle, and not completely enveloping it. It is irreducible and presents no impulse on coughing. As the cyst increases the testicle is borne on its wall, and is seldom if ever behind the swelling. The growth is slow and painless. In many cases the swelling is small and not larger than a marble; in other cases it may reach a huge size.

Diagnosis.—The chief points are the globular shape, position of the testicle, small size, and nature of the contents.

Treatment.—Injection of iodine, and if this do not succeed, a seton or aseptic incision.

Hydrocele of the Spermatic Cord is met with in two forms: 1. Diffuse or infiltrated hydrocele of the spermatic cord; 2. Encysted hydrocele.

1. The diffuse variety is very rare, and consists in an oedematous infiltration of the connective tissue which surrounds and unites the several constituents of the cord. As this tissue is very rich in lymphatics and veins, any obstruction by pressure above, within the abdomen, will give rise to this disease.

2. In the encysted variety the fluid, which is serous, is accumulated in a distinct bag at some part of the spermatic cord. The bag appears to be formed in many cases by the funicular process of the peritoneum being imperfectly closed and unobliterated as far as the external ring, or to some point between this and the upper border of the testis (congenital variety). When the communication with the peritoneal cavity is by a narrow neck it is termed a water-bottle hydrocele.

In other cases it is due to the formation of a distinct cyst, or to dilatation of the organ of Geraldès, or distension of an unobliterated piece of the funicular process; it may occupy the internal ring, be seated near the testicle, or at any intervening place; it rarely exceeds the size of a hen's egg.

Symptoms.—*Of the diffuse form.* A smooth, uniform, cylindrical or pyriform tumour with the large end downwards, from gravitation of the fluid when the patient stands. The cord is enlarged, feeling like a varicocele or epiplocele; the testis and epididymis are normal. The tumour is slow in its formation, not attended with much pain, but a sense of dragging weight. By continued but gentle pressure the swelling can be made to disappear, but returns on the pressure being relaxed, whether the patient be erect or recumbent. There is an impulse on coughing, but not so distinct as in a hernia. This form is less clearly marked and rounded in outline than the encysted, and, unlike the latter, alters its size on pressure.

Of the encysted form. The congenital variety occasions a fulness or swelling along the cord, presenting a slight impulse on coughing, capable of being reduced by pressure or on lying down, and returning on standing; the swelling is soft and fluctuating, and is translucent when examined by transmitted light. The ordinary variety presents itself as a small, distinctly circumscribed, round or oval tumour, filled with pale straw-coloured fluid. When the skin is stretched over it, and it is examined by transmitted light, it is translucent. It may involve the cord at any part of its curve, but is most usual just below the external ring. When high up it can be pushed into the inguinal canal or abdomen, but reappears with a distinct jerk on coughing, standing, or when the cord is pulled. It does not alter in size on compression. There may be an impulse on coughing, but less distinct than in a hernia.

Treatment.—*For diffuse.* Aseptic incision followed by a spica bandage. In the congenital form apply a truss, and afterwards, when adhesions have shut off the hydrocele from the peritoneal cavity, apply the following methods.

For Encysted Hydrocele acupuncture

with a cataract needle; injection of tr. iodi.; the passage of a seton; aseptic incision, the wound being allowed to granulate from the bottom.

Hæmatocele is an accumulation of blood in the tunica vaginalis.

Causes.—It may arise from mechanical injury, as a blow, kick, fall, strain, or puncture; it may follow hydrocele or encysted hydrocele, or arise spontaneously from rupture of an enlarged spermatic vein.

Pathology.—The blood is poured out from ruptured vessels of the gland or tunica vaginalis, or from a small wound penetrating the tunica vaginalis. When the hæmatocele is secondary to a hydrocele the blood may issue from a wound of the cord or testis, or result from a general oozing of the surface of the vaginal tunic when tension is removed. The swelling slowly but gradually increases in size, from a hen's egg to a cocoa-nut or larger. When recent, it contains fluid blood, but in old cases the blood is deposited in fibrinous layers, as in an aneurism; the blood is of a dark brown colour, and when of long standing of the colour of coffee grounds; it may be in various stages of degeneration, and contain crystals of cholesterin. The presence of the blood causes inflammation and considerable thickening of the wall of the tunica vaginalis, which is lined by false membranes and in some instances calcified. In exceptional cases suppuration may ensue, with the formation of an abscess in the tunica vaginalis.

Symptoms.—A tense, smooth, uniform, globular, or pyriform swelling, which appears suddenly after some mechanical injury, and gradually increases in size. The tumour is heavy, with some elastic feeling on palpation, and at the commencement fluctuation. There is no translucency by transmitted light. The skin of the scrotum is dark and discoloured from ecchymosis. The testicle is situated posteriorly, and is painful on pressure; the cord is free and healthy above, and the glands unaffected. The tumour is never double.

Diagnosis.—From hydrocele, by the swelling being opaque, heavier, and following an injury; its sudden development and rapid increase up to a certain size, when it remains stationary; by the presence of ecchymosis of the scrotum; and

lastly, by the solidification which takes place.

From a solid tumour of the testis an old hæmatocele is often distinguished with difficulty, but attention must be given to the history, freedom, and healthy condition of the cord, and, if necessary, a grooved needle or exploratory incision may be used.

Treatment.—In slight cases, rest in bed, with the scrotum raised, leeches above the scrotum, and cold or warm applications; afterwards the patient may move about with a suspensory bandage. Should this fail, tap with a trocar as for hydrocele, and strap the scrotum; repeat the tapping if necessary and inject iodine. When the blood is solid, lay the sac open under aseptic precautions, turn out the clots, wash out the cavity, insert a drainage tube, and dress from the bottom with carbolised gauze. When there is much thickening of the vaginal tunic, part of the thick wall may be cut away with favourable results. If the tumour be large, the wall much thickened, and the patient advanced in life, castration may be required, with removal of the entire mass. If inflammation occur, belladonna and glycerine should be smeared over the scrotum, and warm fomentations applied; should suppuration ensue, treat as an abscess.

Other Varieties of Hæmatocele are: (α) *Encysted Hæmatocele of the Testis*, from extravasation of blood into an encysted hydrocele. (β) *Parenchymatous Hæmatocele*, or extravasation of blood into the substance of the testicle itself, inside the tunica albuginea; this is generally conjoined with hæmatocele of the tunica vaginalis. (γ) *Hæmatocele of the Cord*. This is uncommon, but may be diffuse, or very rarely encysted. The diffuse form is due to rupture of one of the vessels of the spermatic cord from straining, a blow, or other injury, and gives rise to swelling, which may pass along the cord to the scrotum. The symptoms are similar to hæmatocele of the tunica vaginalis. The encysted variety may be caused by hæmorrhage into the sac of an encysted hydrocele of the cord, or by circumscribed extravasation.

Treatment.—Ice, evaporating lotions, counter-irritation; if these measures be unsuccessful, incision with aseptic precautions.

Simple Sarcocoele, or Chronic Enlargement of the Testicle.

Causes.—1. The most frequent origin is syphilis, the disease appearing as a late secondary or early tertiary symptom. In children it may be met with as the result of hereditary syphilis. 2. It may result from some slight injury, as a squeeze. 3. It may follow an attack of acute orchitis. 4. Obstruction of the urethra from stricture or enlarged prostate. 5. Gout, rheumatism, malaria, exposure to wet and cold, venereal excess.

Pathology.—1. Diffuse or interstitial orchitis. There is effusion of lymph in the intertubular, connective and septal tissue of the gland, and in the tunica albuginea and mediastinum; less often in the connective tissue of the epididymis. The deposit is often irregular, only implicating some of the lobules. The lymph develops into small, round, nucleated cells and fine fibres, which become converted into a fibrous tissue, separating the seminal tubes; by the contraction of the new-formed tissue some of the tubes are dilated into irregular spaces; the epithelium lining the tubes undergoes atrophy and fatty degeneration, and is cast off; the walls of the tubes are at first thickened. The process may advance to an extreme degree, so that nothing at last is left of the testicle but a mass of fibrous tissue. In some cases the tunica vaginalis is obliterated by bands of new tissue.

2. *Gummatous Form.*—In some syphilitic cases whitish or yellowish white gummata are formed in the tunica albuginea or in the connective tissue of the testis, as the result of obliteration of the arterioles and fatty degeneration of the tissue; the nodules are streaked with blood vessels at the circumference, and are very hard.

The disease is often accompanied by a small hydrocele, and is then termed *hydro-sarcocoele*. Suppuration may occur in the substance of the testis from the breaking down of gummata, and if the collection of pus be small it may undergo fatty or calcareous degeneration; but in other cases the pus discharges itself through the front of the tunica albuginea and tunica vaginalis, which become adherent, and then through the superficial structures. The sinus thus produced may heal or form a hernia testis.

Hernia Testis.—The opening thus

formed remains patent and increases by ulceration of the skin round it. Through this aperture a reddish yellow fungus protrudes composed of the indurated and altered structures of the testicle, constricted at its base by the tunica vaginalis, beyond this expanding and actively granulating. The amount of protrusion varies from a small nodule to the entire substance of the testicle. The discharge may contain spermatozoa. Occasionally a syphilitic tubercle forms in the skin, and produces a hernia testis by ulcerating inwards.

Symptoms.—1. Slow and painless enlargement of the gland. In some cases the pain may be severe, dull, aching, and extending to the loins, but this is exceptional. 2. The body of the testicle is the part affected, and at first is uneven and knotty, but as the disease progresses it becomes of uniform firm consistence, heavy, very hard, and of an ovoid shape with flattened sides, about the size of a duck's egg or an orange. 3. The testicular sensation is early lost. 4. Both testicles are frequently affected, but rarely simultaneously. 5. The cord is tender and swollen, but not indurated. 6. Hydrocele frequently co-exists. 7. If both testicles be affected sexual desire and power may be absent. Under proper treatment recovery may occur, but in some cases atrophy of the testis results.

Treatment.—Rest, support with a suspensory bandage, and strapping. Leeches, three or four applied to the scrotum two or three times a week. Inunction with iodine and mercurial ointment and belladonna ointment. Attention to the general health, fresh air, cold baths, and good diet. Internally, give iodide of mercury (gr. j), with Dover's powder (gr. v), twice a day, or calomel (gr. ss to j), with pulv. opii. (gr. $\frac{1}{3}$). Abscesses are to be opened as soon as diagnosed. For hernia testis, strapping, with Scott's ointment; the application of iodoform, iodide of starch, nitric oxide of mercury, or red oxide of mercury. If large, it must be removed with the knife or caustic, or the undermined skin divided and all sinuses laid open. Syme recommended an elliptical incision being made round the hernia, and the skin separated from the testicle; the fungus being pressed back the skin was united over it by sutures. Pagan has advised

dissecting down through the soft parts to the tunica albuginea, and incising the ring formed by this, through which the hernia protrudes. If the disease be very extensive, confined to one testicle, the patient in bad health, treatment over a long period of no effect, and pain severe and recurrent; or if the testicle be riddled with sinuses, or extensively involved by gummata, castration should be resorted to. When hydrocele is troublesome it may be treated in the usual manner. If the disease be gummatus, mercurial ointment must be rubbed in the scrotum twice a day, and iodide of potassium in decoction of sarsaparilla or cinchona given internally, with mercurial suppositories. Small doses of opium assist in healing the ulceration. In children a mild mercurial treatment is best.

Tuberculous Sarcocele, or Strumous Testicle, generally occurs in young men, and may be a primary affection, or secondary to tubercular disease of other regions, as the lungs, bones, kidneys, and bladder. It is associated with the development of the bacillus tuberculosis. It often affects both testicles, and may be directly occasioned by a blow, exposure to wet and cold, urethritis, etc.

Pathology.—It occurs in two forms, either as a diffuse strumous orchitis or a disseminated tubercular orchitis. In the *diffuse* form the epididymis is primarily affected, the inflammation beginning, in the lymphoid tissue which surrounds the tubes, as a chronic interstitial orchitis; this is followed by a multiplication of the epithelial cells lining the tubules, and a granular condition of these cells. The tubes become swollen, being filled with the products of exudation and desquamation, which undergo fatty degeneration and caseation. The epididymis is enlarged along its whole length, and can be felt at the hinder, lower, and upper parts of the testicle. The outline of this swelling is very irregular, and it feels indurated and nodular. As a result of the interstitial orchitis and infiltration of the adjacent connective tissue with the products of inflammation and the organisation of these, the blood vessels are compressed, and the blood supply cut off, accompanied by the formation of clots in the vessels. The tissues, deprived of their nutriment, undergo a process of fatty degeneration and caseation, with increase of the area affected. The vas deferens

has its walls swollen and thickened and its canal filled with caseous matter. The walls of the epididymis become converted into cheesy substance which softens, the surrounding cellular tissue is inflamed, the skin becomes adherent, and at last gives way, forming an abscess. Several abscesses usually are present, resulting in troublesome sinuses discharging a thin curdy pus. While this is proceeding the rete becomes affected in a similar manner, and the tubular structure of the testis is studded with grey nodules, which coalesce and undergo fatty degeneration, producing cheesy patches; the connective tissue may become thickened or absorbed; the disintegrated products soften, forming an abscess; the scrotum becomes adherent to the testicle, is inflamed, gives way, and the pus is discharged externally and may be followed by a hernia testis. In the *disseminated* variety fine grey granulations form in the secreting parts of the testicle, and then attack the vas deferens, prostate, and vesicula seminalis on the same side, and may extend to the bladder, ureter, and kidney, and even distant organs, as the lungs or brain, may be secondarily affected. The granulations may soften, forming abscesses, or may undergo caseous or calcareous degeneration, or may become encapsuled. The tunica vaginalis is rarely affected in either form of this disease.

Symptoms.—1. Enlargement of the epididymis, occurring slowly and insidiously, occasioning an indolent, painless, nodular, irregular, crescentic mass behind the testicle. 2. The testicle is often quite normal at first, but after a time a firm swelling is felt in it, merging into that of the epididymis. 3. Testicular sensation is retained, or only lost at a very late period. 4. The cord is enlarged and the vas deferens increased in size and knotty; the vesicula seminalis is enlarged on the same side. 5. Hydrocele is uncommon, and if present, small in size and limited in extent. 6. Abscess, fistulous openings, and hernia testis are common. 7. The other testicle is often affected in the same way, or may atrophy. 8. Emaciation and hectic fever in the later stages, and symptoms of tuberculosis of the lungs, etc.

Diagnosis.—This has chiefly to be made from simple orchitis of syphilitic origin; the following table will clearly show the points of difference.

SYPHILITIC ORCHITIS.	TUBERCULAR OR STRUMOUS ORCHITIS.
1 Body of the testis first affected.	1. Some part of the epididymis primarily affected.
2 Other symptoms of, or a history of, syphilis.	2. Tubercular diathesis, other organs being involved.
3 Uniformly firm and hard; not irregular, except at first.	3. Knotty and irregular, with intermediate soft parts.
4 Oval, with a smooth surface.	4. Crescentic, with an irregular surface.
5 Slight tendency to suppurate, rather to fibroid changes.	5. Suppuration common.
6. Fistulæ uncommon.	6. Fistulæ common.
7. Hernia testis rare.	7. Hernia testis common.
8. Testicular sensation early lost.	8. Testicular sensation retained.
9. Cord unaltered.	9. Cord thickened.
10. Vesicula seminalis normal.	10. Vesicula seminalis enlarged.
11. Hydrocele frequent.	11. Hydrocele rare.
12. Health unaffected and recovery usual.	12. Health generally impaired and recovery uncommon, the gland being, as a rule, more or less destroyed.
13. May occur at any age after puberty.	13. Not uncommon in children and young adults, and rare after thirty.

Treatment.—Fresh air, exercise, change of climate, sea air or a sea voyage is often beneficial; fresh arterial blood from the bullock's heart, which the patient should drink raw, is a most valuable article of diet; cold sponging, and avoidance of all sexual intercourse. Tonics, as iodide of iron, quinine, the mineral acids, cod-liver oil, hypophosphites, tincture of iodine, and arsenic.—Locally. Suspend the part and sponge it frequently with cold water. Iodine lotions, iodoform ointment, or iodide of lead ointment should be applied. All abscesses and sinuses should be laid open, all the cheesy matter scraped out with a sharp spoon, and the cavity stuffed with iodoform gauze. If the patient be in bad health, and exhausted by the discharges, castration should be performed; the same operation is indicated where there are no symptoms of tubercle elsewhere, and the vesiculæ seminales and prostate are healthy, as by this means general infection may be avoided.

Tumours of the Testicle are benign and malignant. The benign growths are pure enchondroma, fibroma, dermoid cyst, and hydatid cyst; the malignant are sarcoma and carcinoma.

Pure Enchondroma occurs before thirty, and presents itself as a slow-growing, very hard and heavy, round or lobulated tumour, with a smooth oval or bossy surface. It is contained within a fibrous capsule, and does not affect the cord or glands.

Fibroma is very rare, and is known by the usual characters of such a tumour.

Dermoid Cyst is congenital, and contains cuticle, hair bulbs, sebaceous follicles, waxy or oily fluid, osseous matter and teeth. It is recognised by its globular outline, unequal consistence, and the oily character of the contained fluid.

Sarcoma is the most frequent form of new growth attacking the testicle. According to Butlin it is most common in childhood under ten years of age, and between the ages of thirty and forty. The following varieties in their order of frequency are met with: round-celled, spindle-celled, and mixed-celled. Lympho-sarcoma, myxo-sarcoma, and chondro-sarcoma are common forms.

Pathology.—Sarcoma may appear as a soft pinkish grey tumour, but may be crossed by fibrous bands, or contain small pieces of cartilage; in some cases the whole tumour is almost converted into cartilage, resembling true hyaline foetal cartilage, and this may undergo calcification to a greater or less extent. Another change to which this tumour is liable is the formation of cysts, the testicle becomes studded with thin walled cysts, varying in size from a pin's head to a walnut, and of a globular shape. The cysts are smooth and lined with a tessellated epithelium, and contain a thin colourless fluid as a rule, but in some instances their contents are viscid and may be stained with the colouring matter of the blood. The cysts are due to morbid changes in the ducts of the

rete testis, or to degeneration and softening, or the occurrence of hæmorrhages. Sarcomatous tissue varying in amount separates the cysts from one another, and in some cases this is thick and in large quantity, and is developed into a more or less perfect fibrous tissue. The sarcoma starts in a cellular proliferation *between* the tubes, compressing and pushing aside the seminal ducts; the tunica albuginea confines the tumour to the testis for some time, but at length may give way, the scrotum be invaded and ulcerate, and the growth protrude as a bleeding fungating mass (*fungus hæmatodes*). Both testicles may be attacked, and hydrocele may complicate the case. Unlike the usual course of sarcoma, secondary deposits are common in the deep inguinal, lumbar, and iliac glands, and this accounts for the extremely malignant nature of this condition. These secondary growths are of the same nature as the primary, and may attain a large size and spread to the kidneys, liver, or lungs.

Symptoms.—In the early stage a sarcoma forms an oval or somewhat rounded swelling of the body of the testis, obscuring the epididymis; the outline is uniformly smooth and consistence firm. The rate of growth varies, and may be slow at first and then rapid, the increase in size being often attended with unevenness and irregularity of the surface, together with inequality of consistence in different places. There is not much pain or tenderness, but a sense of weight and dragging on the cord; the testicular sensation is soon lost; the cord and scrotum do not become affected until a late period. When the glands are affected, those just above Poupart's ligament can be felt to be enlarged. If cysts be present, the tumour has an elastic fluctuating feeling, and the inequality in consistence is well marked; by transmitted light it is not translucent, and if tapped with a trocar, clear, glassy, mucoid fluid is drawn off.

Carcinoma is almost always of the encephaloid form, and most commonly occurs from thirty-five to forty-five. It commences in the body of the testis, by the proliferation of the epithelium lining the tubuli; gradually the glandular substance is destroyed, and the whole testicle converted into a cancerous mass.

The tumour is very soft, of a pinkish white colour, and abundantly supplied with vessels; on section a milky juice can be squeezed out. As the result of its softness, effusion of blood is apt to occur from any slight blow or external injury. It may be associated with the formation of cysts, but this is not nearly so common as in the case of a sarcoma. It is liable to undergo degenerative changes, such as softening and fatty degeneration. The epididymis and cord, lumbar and pelvic glands, are apt to be secondarily affected, and afterwards the lungs and the liver. The surfaces of the tunica vaginalis are more or less adherent, and what remains of its cavity filled with a bloody fluid.

Symptoms.—A rapidly progressing enlargement of the testis, unattended with inflammation. The swelling is at first hard, with a smooth surface, similar to a sarcoma; after a time the mass becomes rounded and softer, having a semi-fluctuating feeling at some parts, while it is still hard at others. The pain, if present, is dull and aching, and an early loss of testicular feeling is occasioned. The scrotum is reddish or purple, and covered with turgid, tortuous veins. The cord is free at first, but becomes enlarged from undue fulness of its vessels, or hard and knotty from infiltration with cancer. Hydrocele is very exceptional. Only one testicle is affected, and misplaced testicles are more liable to this complaint. As the disease advances the patient's health is affected, and he becomes cachectic. If allowed to run its course, the scrotum becomes infiltrated, adherent, ulcerates, and a *fungus hæmatodes* protrudes. A fatal result occurs in from eighteen months to two years, from exhaustion or secondary deposits.

Diagnosis.—Non-translucency distinguishes tumours of the testis from most hydroceles; from a non-translucent hydrocele and hæmatocele the diagnosis is more difficult, but the history of the case, detection of the testicle at one part only of the swelling, freedom of the cord, and absence of glandular changes, will help as distinguishing points. In all doubtful cases a preliminary puncture, or, better still, an incision, will clear any doubt. From simple orchitis, tumours are distinguished by their continuous and rapid growth in spite of treatment; their unequal consistence, with perchance

the presence of cysts or cartilage; enlargement of the cord and lymphatic glands; absence of pain or tenderness. Tuberculous sarcocele is recognised from a tumour by the epididymis being so early affected, the great tendency to suppuration and to affection of other organs.

To ascertain the variety of tumour is often by no means easy; benign tumours are known by their slow course, great hardness, and bossy outline. Malignant grow rapidly, with early loss of testicular feeling, and enlargement of the cord; when the glands or scrotum are implicated there can be no doubt. If a tumour be met with in the testicle in a child under ten, it will be a sarcoma; if both testicles be affected the disease is also sarcomatous. A carcinoma is, as a rule, more rapid in its course than a sarcoma.

Treatment.—Castration, which should be performed as soon as possible, and in malignant cases before the cord is affected.

Castration.—Instruments required: 1. Scalpel; 2. Sharp hook; 3. Blunt hooks; 4. Stout whipcord; 5. Fine ligatures; 6. Artery, pressure and torsion forceps; 7. Silk and wire sutures; 8. Scissors; 9. Strapping; 10. Lint and absorbent cotton; 11. Iodoform; 12. Anæsthetic and inhaler; 13. Razor; 14. Claw forceps; 15. Esmarch's tourniquet.

The parts are to be shaved, and the presence of a hernia looked for; if present, this should be reduced, and its sac must not be subsequently interfered with. The patient lies on his back with the thighs widely separated, and hanging over the end of the table; the operator stands in front, between the patient's legs, takes the testicle in the palm of the left hand, making the skin tight over the anterior surface of the tumour.—(1st Step.) If the tumour be small, a longitudinal incision is made, extending from the external abdominal ring quite to the bottom of the scrotum. If large, two semi-elliptical incisions are used, enclosing a sufficient portion of the scrotum. The tunica vaginalis is then opened.—(2nd Step.) The cord is now isolated and seized by an assistant with a clamp, pair of claw forceps, or the fingers, or tied with a piece of tape; if the tumour be large, an Esmarch's tourniquet is

passed round the root of the scrotum, tightly crossed, and carried round the body, where it is fastened.—(3rd Step) The testicle is now forced out of the incision by compressing with the left hand, aided by tearing through the coverings, the knife being used as sparingly as possible, and care being taken not to interfere with the scrotal septum or other testicle. All bleeding points in the scrotum should be secured with pressure forceps.—(4th Step.) The cord is now divided as low as possible, except in malignant tumours, when it must be well exposed by dissection up to the abdominal ring, well drawn down, ligatured as high as possible, and divided close to the seat of deligation.—(5th Step.) Ligature of the cord. The vessels of the cord, the spermatic artery, and deferential artery should be tied separately with prepared catgut. In malignant disease the cord may be tied *en masse*, or better, in two parts, after transfixion with a double carbolised silk ligature mounted on an aneurism needle. All bleeding vessels of the scrotum, however insignificant, and generally a good number, must be tied with carbolised catgut or twisted as the pressure forceps are removed, as, if this be not well done, secondary hæmorrhage will be almost inevitable. The wound should be well washed out with carbolic acid solution applied by an Esmarch's irrigator, a drainage tube inserted, and the incision united with sutures, an additional fine continuous suture being applied to the edges of the skin to prevent inversion by the dartos. No dressing is required, but the aseptic treatment is useful, if it be possible.

It must be remembered that in children the peritoneum may be opened if the processus vaginalis testis be not obliterated, and peritonitis may follow.

Death has resulted from hæmorrhage, peritonitis, erysipelas, pyæmia, and tetanus.

If secondary hæmorrhage occur, the wound must be reopened, and the vessel sought for in the inguinal canal, the anterior wall of which must be divided if necessary.

Cases requiring Castration.—1. For malignant disease, whether sarcoma or encephaloid. 2. For benign tumours. 3. In some cases of tubercular disease. 4. In hernia testis not amenable to other

treatment. 5. In rare cases of hæmatocele.

Spermatorrhœa, or involuntary seminal discharges, is chiefly met with in young men from eighteen to thirty.

Causes.—Masturbation, sexual excess, forced or unavoidable continence, studious or sedentary habits, an acid state of the urine, phimosis, stricture, fissure of the anus, balanitis, hæmorrhoids, ascarides, obstinate constipation and dyspepsia; it is also met with in cases of disease of the cerebellum and spinal cord. Trousseau considered this disease due to a vitiated condition of the nervous system, and especially to occur in men who have been subject to incontinence of urine in childhood. Gross believes it to result from irritation at the neck of the bladder, the ejaculatory ducts, and the seminal vesicles, the mucous membrane of which is in a state of morbid sensibility. Clemens opines that the urethral mucous membrane is in a state of hyperæsthesia, from some affection of the spinal cord. Lallemand thinks the disease is due to irritation of the spermatic ducts, the result of chronic inflammation, particularly urethritis.

Symptoms.—Nocturnal emissions three or four times a week, or more frequently, generally occurring in the early morning, between sleeping and waking. Hammond writes: "In young men of entirely chaste habits, it generally happens that soon after the supervention of puberty nocturnal emissions begin to occur. So long as they are not more frequent than once in a fortnight, they are strictly within the limits of health, at least, the health of civilized man. They show that in the course of the development of the reproductive system, semen is being secreted, and that when the vesiculæ seminales become full, nature steps in, and in her own way empties them." Emissions during the day, under slight excitement, occur as the disease progresses. These seminal losses are attended at first with erection, and the usual sensation, but later on occur without erection or sensation. If sexual intercourse be attempted, ejaculation occurs before penetration is accomplished. These are the local symptoms, but it is to be remarked that real spermatorrhœa is a rare affection, and patients, particularly those who read the quack literature with which all large towns is flooded, will constantly consult a surgeon

for this disease when there is a little gleety discharge, or slight loss of mucus, or even a little abnormal secretion of the preputial glands, or phosphatic condition of the urine. For one genuine case a hundred spurious present themselves. The general symptoms are due to dyspepsia and nervous disturbances: the dyspeptic phenomena are heartburn, flatulence, constipation, headache, palpitation, cold extremities, disturbed sleep, loss of appetite, etc. The effect on the nervous system is shown by languor, incapacity for work, pallor of the countenance, aching pain in the loins, nervous tremors, restlessness, enfeeblement of mind and loss of memory, a timid desponding manner, aversion to company and desire to be alone, impairment of vision with dread of light, tinnitus, epilepsy, and even paralysis. The patient falls into a hypochondriacal condition, and thinks of nothing but his sexual organs, a condition which may terminate in monomania, melancholia, or dementia.

Diagnosis.—Examination of the discharge by the microscope will prove whether this is seminal, by the presence of spermatozoa in it.

Treatment.—The patient must be encouraged with the hope of a speedy recovery, and cautioned against advertising quacks. All causes of irritation must be removed, and the sufferer particularly warned against masturbation and sexual excess; if necessary, the penis should be blistered with tr. iodi., or acet. cantharides. Mild aperients are useful, as cascara sagrada, and a light diet. Moderate daily exercise. The patient should sleep on a hard mattress, lightly covered, and have no supper; he should be roused after six or seven hours' sleep, and never give way to a second sleep. Agnew advises that the patient should be roused and pass his water at two or three o'clock in the morning. An alkaline treatment is good for the robust. For the weak, syrup of the phosphate of iron and strychnia, or tr. of the perchloride of iron, with nux vomica and cantharides. Other remedies are, belladonna, bromide of potassium, infusion of digitalis, gelseminum, camphor, lupulin, hyoscyamus, ergot and diluted sulphuric acid, and tr. matico. Bathing the testicles and perineum with cold water, and letting the testicles hang in cold water

night and morning for five or ten minutes. Cold hip baths night and morning, or cold shower baths. Galvanism by means of a urethral electrode, applied to the prostatic urethra, the other electrode being placed on the perineum, sacrum, or pubes; three to twenty milliampères may be used, and the current should be frequently reversed and interrupted. Locally, the application of nitrate of silver in stick or solution (gr. x—xx to 5j) to any tender spot in the urethra, by means of a syringe catheter. The passage of a metallic instrument into the bladder. Leeches, or blisters to the perineum. When the patient is cured, the best protection against a relapse is marriage, and an active congenial outdoor occupation.

Spasmodic Spermatorrhœa occurs between twenty-five and forty. It consists in erection and emission taking place simultaneously, or emission after the erection has subsided.

Causes.—Disease of the generative organs, as stricture, varicocele, etc. Residence in warm climates. It often occurs in strong athletic men.

Treatment.—Galvanism; bromide of potassium, ammonium or sodium (gr. xx—xxx); cold bathing; blisters to the perineum; belladonna; light diet; no stimulants.

Impotence in the Male is classed by Hammond, in his excellent work on that subject, into: 1. Absence of sexual desire; 2. Absence of the power of erection and of consequent intromission; 3. Absence of the power of ejaculating the seminal fluid into the vagina; 4. Absence of the ability to experience pleasure during the act of copulation and during the emission of semen.

1. *Absence of Sexual Desire. Causes.*—

(a) Original absence of sexual desire as an idiosyncrasy. (β) Acquired absence of desire, from mental preoccupation, treated by entire change of habits; abstinence from mental work, with sufficient amusements and physical exercise, together with strychnia in small doses. (γ) Masturbation carried to excess. (δ) Perversion of desire exists in some cases, the individual being impotent towards women, but by an act of the imagination the state of erection and emission are capable of being produced. In other cases there is sexual impotence except as regards women of a certain type, or

peculiarly clad, etc. (ε) In cases of enforced continency, absence of sexual desire may result.

Treatment.—Use of bromides, avoidance of sexual excitement, obtain the patient's confidence, and re-assure him as to his eventual recovery.

2. *Absence of the Power of Erection and of Consequent Intromission* (most common).

Causes.—Early sexual excess before the organs are fully matured, particularly as the result of excessive and premature indulgence in masturbation. Sexual excess in adult life. Hammond lays down as a practical rule that intercourse once a week can, as a rule, in healthy men be taken as a guide from the twenty-fifth to the fortieth year; previous to the twenty-first year sexual intercourse should not be practised at all; and between that age and twenty-five, if indulged in, it should certainly not be more frequently than once in ten or twelve days; and it is a law to which there are no exceptions, that the greater the excess the sooner will the natural power be lost. Other causes are obesity; emaciation; brain affections, particularly diseases of the cerebellar organs,—an attack of apoplexy often extinguishes both the desire and power for copulation; affections of the spinal cord, though in the early stages the ability to have connexion is in some of these diseases increased, and often, though weakened, is not destroyed; diseases or injuries of the nerves supplying the generative organs; excessive horseback riding; certain medicines, as iodine and its compounds; nitrate of potash; excessive abuse of alcohol, habitual inebriates often being unable to exercise their sexual powers; bromides; castration; excessive desire, as is frequently seen in young married men; fear, or want of confidence; hypochondriasis; oxalic acid or phosphatic diatheses.

Treatment. Hygienic.—*Rest and complete abstinence from all sexual excitement.* In patients over forty, and in whom the condition has lasted six months, no attempt at intercourse should be made for over a year. *Rest of mind from all lascivious thoughts* by a course of study or foreign travel. Baths, cold plunge or shower; sea-bathing; alternate cold and warm douches to the sexual organs; Russian or Turkish baths. The diet

must be plain and nutritious, animal food and fat being prominent constituents. Alcohol must be avoided. Daily exercise in the open air, but not carried beyond the point of fatigue. Horse-back riding must be eschewed. Patient must sleep on his side and not on his back, and the bed should be a hard mattress.

External Remedies.—Electricity in the form of galvanism or faradism. In using galvanism, bring into use as strong a current as will cause the patient a slight degree of discomfort. The electrodes are placed, one in the nape of the neck, and the other stroked down the spine for a few minutes, particularly down the lower dorsal, lumbar, and sacral regions; then leave the electrodes in their position for some minutes; next one electrode is placed on the sacrum and the other on the perineum. Fourthly, one electrode is placed on the sacrum and the other on the glans penis, making and breaking the current with the interruptor. Lastly, a weak current is applied to the testicles. Faradism is also very useful, applied in the same manner; over the spine and penis a wire-brush electrode should be used, the other electrode being a metal disc covered with wash-leather. The galvano-faradic current is also of service.

Internal Remedies.—Phosphorus in the form of phosphide of zinc or dilute hypophosphorous acid, nux vomica, or strychnia. Hammond uses the following pill:

R Zinci phosphidi gr. x,
Nucis vomicae ext. gr. xxxij.

M. ft. in pil. No. C. Dose, one three times a day after meals.

or this mixture:

R Strychnia sulphatis gr. iij,
Acid, hypophosp. dil ʒiv.

M. ft. sol. Dose, m̄x in water three times a day.

The dose to be increased a drop every day up to twenty-five drops, or phosphoric acid may be used instead of dilute hypophosphorous acid. I have found Easton's syrup and syr. ferri. phosph. co. serviceable. Cod-liver oil is a valuable adjunct. In recent cases tr. cantharides m̄ xv t.d.s.

In impotence depending on disease of the brain or spinal cord, or on protracted and wasting diseases, as typhoid fever,

diabetes, etc., the affection causing it must be treated.

3. *Absence of Power of Ejaculating the Seminal Fluid into the Vagina.*

Causes.—Absence of the penis, congenital or acquired; smallness of the penis (very rare); great size of the penis; bifurcation of the male organ; attachment of the penis to the scrotum; hypospadias and epispadias, if the opening be near the root of the penis; strictures of the urethra; enlarged prostate; spasmodic obstruction; urethral calculus; excessive enlargement of the prepuce; carcinoma and syphilitic warts; wounds, with loss of substance of the cavernous bodies, or extravasation of blood into these bodies; foreign bodies; phimosis; great incurvation of the male organ from fibrous bands, cartilaginous degeneration, etc. Paralysis of the compressor urethræ muscle; anæsthesia of the glans (best treated by electricity); hyperæsthesia (indicates the necessity for the use of bromides and lotions of tannic acid, gr. x to ʒj). Absence of testicle; non-descent of the testicles; arrest of development of the testes; atrophy of the testicles, arising from cerebellar disease, inflammation, metastasis, or anything which deprives the organ of blood supply or nervous influence. Bodily deformity or peculiarity, as ankylosis of the hip, tumours, elephantiasis of the scrotum, excessive corpulence, etc.

4. *Absence of the Ability to Experience Pleasure during the Act of Copulation and during the Emission of Semen.*

Causes.—Sexual indifference; central causes, as diseases of the brain, mental overwork; excessive sexual indulgence; advancing years; circumcision; extreme narrowness of the penis.

Neuralgia of the Testis occurs chiefly in young men of an irritable, nervous temperament.

Causes.—External violence; subsequent to an orchitis; stone or disease of the kidney, ureter, bladder, and urethra; varicocele; hæmorrhoids; dyspepsia; malignant disease of the spine. General conditions occasioning this affection are malaria, gout, anæmia, and a depressed state of health.

Symptoms.—Intermittent paroxysmal attacks of severe pain situated in the epididymis, or shooting up the cord to the groin; the pain may be so severe

as to cause the patient to roll on the floor in agony; during the paroxysms the testicle is closely retracted, and very sensitive to the slightest manipulation. Occasionally the pain is more of a dull aching character, and relieved by pressure and friction; in some cases the pain manifests itself during connexion. The testicle may atrophy as a rare event.

Treatment.—Quinine, iron, cod-liver oil, zinc, strychnia, aconite, and arsenic. The bowels must be regulated. Hypodermic injection of morphia. Removal of any cause of irritation, and the liver and stomach attended to. Counter-irritation along the course of the cord. Conium and belladonna ointments smeared over the scrotum. Galvanism is often of great service, as recommended for impotence.

Varicocele, or Enlargement of the Spermatic Veins, generally commences about eighteen or twenty, at the period between puberty and manhood.

Causes.—The length and winding course of the veins; the numerous anastomoses; the slight support afforded by the scrotum; the enormous vascular distension during sexual excitement; the fewness of the valves; and the pressure the veins are subjected to in their passage through the inguinal canals, predispose to this affection. Exciting causes are venereal excesses, masturbation, horseback riding, continued and prolonged standing or walking; relaxation of the scrotum from debility; straining at stool; and the presence of tumours in the groin or pelvis.

The left side is the one generally implicated, which has been accounted for by the facts that it is exposed to the pressure of the fæces in the sigmoid flexure of the colon; that the left testicle hangs lower than the right; that the left spermatic vein joins the left renal vein at right angles to the stream of blood flowing through that vein to the vena cava, and also at a higher level than the junction of the right spermatic vein.

The testicle is often smaller than the natural size as the result of diminished arterial blood supply, and defective development, but true atrophy is very rare.

Symptoms.—1. A tumour of pyramidal shape with its base resting on the testicle, and its apex reaching along

the cord. It is soft, compressible, and knotty, feeling like a bag of earth-worms; the tumour increases in size on standing or coughing, and diminishes on lying down. 2. The dark veins can often be seen through the skin. 3. There is a feeling of weight, and sometimes a dull, heavy, aching pain extending up the cord to the groin and back; as a rare event neuralgia of the testis is present. 4. Debility of the generative organs, with spermatorrhœa, sometimes accompanies it, but this is infrequent.

Diagnosis is made from hernia and hydrocele by the feel of the swelling; its broad base, and narrow apex; by it diminishing on the patient lying down and filling up on his standing, in spite of pressure being made on the inguinal canal; and by its non-translucency.

Treatment. Palliative.—Suspensory bandage; drawing the lower part of the scrotum through a ring made of soft silver and covered with wash-leather; a well-adjusted truss; excision of the lower part of the scrotum; cold douching of the genitals; sea-bathing; iron; ergot, tr. hamamelis applied as a lotion externally and given in small doses internally; strict attention to the bowels.

Radical Cure may be attempted: 1. When the varicocele is, in spite of treatment, increasing and causing pain or annoyance; 2. Where a varicocele is a bar to entering the public services; 3. If the testis be markedly smaller than its fellow; 4. In cases of spermatorrhœa. The object is to obliterate the veins by exciting adhesive inflammation in them, (*α*) by ligature, (*β*) subcutaneous section, (*γ*) by exposure, (*δ*) cautery, (*ε*) aseptic method.

(*α*) *By Ligature* (Vidal's operation).—The vas deferens, which can be distinguished by its firm, whipcord-like feel, is separated from the veins and held by an assistant; an iron pin bored with a hole at each end is passed between the vas and the veins; a silver wire threaded on a special needle, so that the wire will not catch, is passed in at the same hole in the skin as the pin. traverses between the veins and integuments of the scrotum, and made to issue at the same place as the pin made its exit. We have now the silver wire on one side of the veins and the pin on the other: the ends of the wire

are threaded through the holes in the pin, which is twisted round until the veins be compressed. The wire is tightened day by day by turning the pin, and cuts its way out in a week or ten days.

Subcutaneous Ligature (Erichsen's method).—A needle carrying a silver wire is passed between the veins and cord, re-entered at its point of exit, and returned in front of the veins between them and the skin, coming out again at the hole where the needle was first entered. The veins are thus embraced in a loop of wire, the ends of which emerge at the same opening, and are constricted by twisting the wire. Carbolised silk or chromicised catgut may be used instead of wire, and tightly tied, the ends being cut off short.

Ricord's Method.—A needle is passed carrying a thread between the veins and the cord; the thread is fastened to a loop of strong ligature, and drawn back, leaving the loop at one puncture and the two ends at the other. The needle and thread are then passed again in the opposite direction through the same punctures, but in front of the veins, and a second ligature drawn through. The bundle of veins is now included between two double ligatures, one passing over and the other beneath it. The ends of the thread on each side are passed into the loop of the other, and by drawing these ends in opposite directions the vessels are tied beneath the skin.

(β) *Subcutaneous Section*.—Two pins are passed through the scrotum between the veins and vas deferens, an inch apart. Opposite to each pin the skin is to be protected by a piece of cork or cardboard; a figure of 8 suture is to be thrown round each pin, so as to compress the vein firmly. A fine knife is now introduced with the veins in front and vas deferens behind, the veins cut across between the needles subcutaneously, the testicle being drawn down. After forty-eight hours the pins are removed.

(γ) *By Exposure* (Rigaud's method).—Pinch up a transverse fold of skin, transfix it, dissect out the veins carefully, pass a strip of well-greased linen underneath them, and bind a pad of lint over

them. The veins shrink, and are converted in a few days to a fibrous cord.

(δ) *Cautery*.—Pearce Gould recommends that the vas deferens should be carefully separated from the veins, the skin pinched in between the two and transfixed with a slender knife, and divided parallel with the vas for one-third of an inch. Through this incision a needle armed with a platinum wire is passed, and returned through the same skin holes. The ends of the loop are to be fixed to an *écraseur*, and the current from one cell of a Grove's battery or of a small bichromate battery passed through it. By this means the veins are divided without hæmorrhage. Hamson exposes the veins by an incision, and destroys them with the thermo-cautery.

(ϵ) *Aseptic Method* (Howse).—The skin on the affected side is shaved, the patient being recumbent, and under an anæsthetic an incision is made for about $1\frac{1}{2}$ inches over the most prominent part of the varicocele, usually beginning about half an inch below the external abdominal ring. If the varicocele be large the veins bulge into the wound. An aneurism needle threaded with carbolised catgut is then passed round the corresponding portion of varicocele above and below, the ligatures are tied and cut short, and the included portion of the varicocele is removed with scissors. During this step care should be taken to disturb the cellular tissue and vessels in relation with the vas deferens as little as possible. The wound in the scrotum is then closed with one or two carbolised silk or silver sutures, a drainage tube inserted, and the usual aseptic dressings are applied, the operation being performed throughout with strict aseptic precautions. The patient is kept in bed for two weeks, after which he may get about with a suspensory bandage. The full benefit of the operation is not seen for a month afterwards, as a mass is felt up to this time, due to the healing of the veins and coagulation of the blood.

The *danger* of operations for varicocele are, thrombosis, phlebitis, pyæmia, atrophy of the testicle, gangrene of the testicle, and return of the varicocele if all the veins be not obliterated.

CHAPTER XXXVI.

DISEASES OF THE PROSTATE GLAND.

Acute Prostatitis, or acute inflammation of the prostate gland, generally results from cystitis, urethritis, stricture, the use of instruments, or other mechanical violence. It is very rarely met with as an idiopathic affection. The predisposing causes are gout and rheumatism, alcohol, and excessive sexual excitement.

Symptoms.—1. Deep-seated dull pain, weight, and fulness about the perineum and rectum. 2. Frequent desire to pass water, attended with difficulty, and spasmodic pain, especially at the end of micturition. 3. Shooting pains in the back, loins, and thighs, increased on moving or sitting. 4. Defæcation occasions much pain. 5. On introducing the finger into the rectum the prostate is found enlarged, prominent, hard, hot and tender. 6. Hæmorrhoids sometimes result, and retention of urine. 7. Rigors, with general fever and much constitutional disturbance, are present.

Prognosis.—Acute prostatitis runs its course in seven or eight days, terminating in resolution, chronic prostatitis, or suppuration.

Treatment.—Rest in bed with the hips elevated. Copious drinks of barley water or linseed tea. Acetate of potash, with aconite and antimony. Purgatives and a low diet. Ten to twenty leeches to the perineum, or this may be cupped to six or eight ounces. To relieve pain, belladonna and opium suppositories, antipyrin, or chloral; warm hip baths of ten minutes' duration frequently repeated, and hot poppy or landanum fomentations. Belladonna and glycerine are to be smeared over the perineum. Retention must be treated as previously directed.

Chronic Prostatitis may follow the acute form, obstinate gonorrhœa, stricture, syphilis, vesical calculus; it may also arise from mechanical violence or sexual excess.

Symptoms.—Some frequency of micturition. Pain felt at the end of the penis or neighbourhood of the anus after passing urine, and occasionally with the last few drops a little blood may appear.

The stream is less forcible than natural, and the urine cloudy with muco-purulent deposit. There is often a gleet discharge and a sense of weight, heat, and dull pain in the perineum. Nocturnal emissions, together with pain during sexual intercourse, are pretty frequent. Constipation of the bowels and difficulty in defæcation are common. On passing the finger into the rectum, the prostate is found to be tender, enlarged, and hard in one or both sides.

Diagnosis.—From stone this disease is distinguished by the history of the case and by sounding.

Treatment.—Rest in bed at first. Alcohol, severe exercise, and sexual intercourse must be forbidden. Blister the perineum by liq. epispasticus or iodine; or insert a seton in this region. Tonics, as iron, quinine, nux vomica, with a good diet, and attention to the bowels. Cold hip baths when the tenderness has subsided, and a course of sea bathing. Iodide and bromide of potassium combined with bicarbonate and tartrate of potash and ergot. Some cases are improved by the passage of a steel sound from time to time. If nocturnal emissions be conjoined, the application of a solution of nitrate of silver (gr. v—xx to ʒj) to the prostatic part of the urethra is useful.

Prostatic Abscess may result from acute prostatitis in debilitated subjects, from the breaking down of tubercular deposits, from calculus or malignant disease, or follow chronic prostatitis or hypertrophy of the prostate.

Symptoms.—When acute, the symptoms of acute prostatitis are increased in severity, rigors, fever, increasing pain and difficulty in micturition and defæcation; a feeling of tightness and pulsation in the perineum or neck of the bladder. Delirium may be present and retention of urine. On examination per rectum, fluctuation can be detected; if the matter advance towards the perineum there is a marked swelling with œdema and redness of the skin. When

the abscess is chronic it progresses very insidiously, with some pain about the perineum, and a general feeling of illness, but no acute symptoms, and fluctuation may be very obscure. Prostatic abscess generally opens into the urethra, particularly during catheterism; sometimes its evacuation takes place into the rectum; if the prostatic fascia become thickened and detached from the gland, the pus may burrow between the rectum and the bladder, and the abscess open into the pelvis; occasionally the abscess points in the perineum, and as a rare event opens the bladder or peritoneal cavity.

Prognosis.—Acute abscess generally terminates favourably, but there is a risk of a fistula remaining; chronic abscess is generally a dangerous affection.

Treatment.—To limit the suppuration, the measures recommended for acute prostatitis must be vigorously followed. Retention of urine must be relieved by a catheter. To afford an outlet for the matter a median incision should be made in the perineum, from $1\frac{1}{2}$ inches to 2 inches deep, directly brawny induration is felt, without waiting for fluctuation. If fluctuation be felt through the rectum the abscess may be opened by a curved trocar, or by a small incision through the anterior wall of the bowel. Periprostatic abscess situated outside the capsule require the same treatment.

Hypertrophy of the Prostate never occurs before the age of fifty-four years, and is most common from fifty-seven to sixty.

Causes.—These are not well known. Reginald Harrison is of opinion that the prostate is a support to the bladder, and a muscular organ aiding the natural retention of its contents; hence it is called into greater requisition in advancing years, as muscular activity diminishes, and takes on a condition of hypertrophy, excess of quantity making up for deficiency in quality. Gouty individuals of plethoric habit of body who follow sedentary occupations are especially prone to this disease.

Characters.—It consists in an excess of development in the unstriated muscular fibres, connective tissue and glandular tubes and crypts which compose the organ. The unstriated muscular fibres and connective tissue may alone be hypertrophied. Most commonly the whole gland is involved, although not uniformly,

as sometimes one lateral lobe is enlarged to a much greater extent than the other, and very commonly the median portion grows in a backward direction towards the cavity of the bladder, forming a rounded tumour, and much impeding micturition. The consistence is very variable, and may be harder or softer than the normal condition. The size may be equal to that of a walnut in slight cases, and exceed that of a goose's egg in more pronounced specimens. Frequently this hypertrophy is accompanied by prostatic glandular tumours of a non-malignant character, and met with in two forms: (α) Isolated tumours made up of a compact tissue like that of the prostate, but with less of the glandular structure; these may occupy any part of the organ, but are most common in the lateral lobes; sometimes they are completely isolated by a limiting fibrous cyst. In diameter they vary from $\frac{1}{16}$ to $\frac{5}{8}$ of an inch, and are easily shelled out owing to their slight connexions with the gland. (β) Out-growths continuous with the prostate gland, which have a great tendency to assume a polypoid form, and become pedunculated; this process is most frequent in the median lobe, but is also met with in the posterior part of the lateral lobes.

Mechanical Effects.—The first and most important is obstruction to the flow of urine from the resulting changes in the course and length of the urethra; the antero-posterior diameter is increased at first, and the transverse diminished; the length of the prostatic urethra is augmented, and it becomes tortuous; when the middle portion is enlarged, the urethra is suddenly curved upwards at the neck of the bladder, whereas when a lateral lobe is unequally hypertrophied the urethra assumes a lateral curvature in the direction of the enlarged lobe. The inner orifice of the urethra is changed in shape; in affection of the median lobe it takes on a crescent shape with the convexity upwards, and in enlargement of either lateral lobe, the convexity of the crescent lies towards the side opposite the enlarged lobe. Sometimes the orifice is overlapped by a pedunculated out-growth from the median lobe forming a valve which completely occludes the urethra. The bladder becomes greatly thickened from hypertrophy of its muscular coat, fasciculated, and sacculated from

the constant obstacle to the evacuation of its contents, and a pouch forms behind and below the enlarged prostate, in which a residuum of urine always remains, and in which mucus and phosphates are apt to collect; the result of these changes is to produce a chronic cystitis. The ureters are unable to empty their contents into a bladder in such a habitual state of distension, and become dilated, with thickened or attenuated walls. The pelves of the kidneys are similarly affected, interstitial nephritis arises, followed by abscess and uræmia.

Symptoms.—1. Diminution in the force of the stream, straining in passing water. 2. Increased frequency of micturition, particularly in the morning and during the night. 3. Pain before passing water, referred to the neck of the bladder, with a feeling of fulness and uneasiness about the perineum. 4. The urine falls directly downwards and is not ejected in a stream, and straining does not augment the flow. 5. As the obstruction increases, mucous discharges from the urethra, tenesmus, prolapsus ani, and hæmorrhoids occur from the forcible expulsive efforts; occasionally swollen testicle and hernia are produced. 6. Frequent erections are not uncommon. 7. Chronic cystitis with its attendant symptoms appears sooner or later. 8. Hæmorrhage may be met with at any time, the veins round the prostate (prostatic plexus) become engorged and bleed into the bladder; this hæmorrhage is sudden and copious.

As the disease advances the bladder is unable to completely relieve itself, and is said to be engorged, that is, containing a

varying amount of urine after the patient fancies he has fully micturated. At night the urine dribbles away unconsciously, which is the result of overflow, and *indicates retention, not incontinence*; there is dulness on percussion over the pubes. The general health suffers, and the patient is liable to feverish attacks. Retention may occur from exposure to cold or venereal excitement. The urine contains a glairy tenacious mucus and phosphates, it is generally thick, fetid, and highly alkaline, with an offensive ammoniacal odour. Phosphatic calculus is of frequent occurrence.

Diagnosis is ascertained by rectal and urethral examination. The patient is placed on his back, and the surgeon introduces his left forefinger, well greased, into the rectum, noting the size and form of the prostate, its degree of enlargement, and whether this be more pronounced on one side than the other. If there be a swelling it is necessary to feel whether it be hard or soft fluctuates, or be tender. With a catheter in the bladder the thickness of the prostate can be perceived per rectum. The urethral examination is made by directing the patient to pass as much water as he possibly can, and then introducing a French coudée catheter (Nos. 14 to 16), which must be well depressed as it enters the bladder; in cases of prostatic hypertrophy a varying amount of residual urine, which may even reach several pints, will be drawn off and should be measured.

To diagnose hypertrophy of the prostate from stricture the following table will be of service:—

SYMPTOMS.	HYPERTROPHY OF PROSTATE.	STRICTURE.
Stream.	But little diminished in size.	Small.
Seat of obstruction.	Seven inches from meatus.	Within six inches from meatus.
Influence of volition.	Straining does not increase the flow of urine, or even diminishes it.	Straining increases flow.
Age.	Appears after fifty.	Occurs before fifty.

Prostatic enlargement is known from calculus by the use of a sound; micturition in stone occurring more frequently in the daytime; and florid bright blood presenting itself after exercise.

To distinguish the disease from vesical tumour is sometimes very difficult; in the latter, microscopical examination of the urine may reveal the structure of the

growth; more pain is caused on passing an instrument; and the urine contains bloody discharges and flocculi, with sabulous matter; finally the electric endoscope may render service.

Atony of the bladder and paralysis are recognised from hypertrophy of the prostate, by the absence of physical signs; by the stream flowing without

any force when a catheter is introduced ; by the attack occurring suddenly in atony, and being accompanied by paralysis of the lower extremities in paralysis.

Treatment.—"To prevent the occurrence of hæmorrhage, great care should be taken before the first catheterism. The catheter should never be used, at least on a first occasion, upon a person while standing, or in any other than the recumbent posture, and the instrument should be of such a calibre (No. 6 or 7) as to prevent too rapid emptying of the bladder. Neither coughing nor straining on the part of the patient, nor hypogastric pressure by the surgeon's hand should be permitted" (Morris). When a patient complains of symptoms of enlarged prostate it is always necessary to pass a catheter, but this should not be executed without taking proper precautionary measures, such as before directed, and it is advisable to perform the operation in the patient's own bedroom, so that he can at once go to bed ; a small dose of opium before catheterisation is of great service. As a general rule, the regular use of a catheter twice a day is required ; the best instrument is a French coudée, but in some cases a bicoudée catheter is more easily passed, in others an English gum elastic kept ready for use on an exceedingly curved stylet. The forefinger should be used as a guide in the rectum, and the pelvis raised on a pillow. Occasionally a silver prostatic catheter is necessary, four inches longer than an ordinary catheter, with its curved portion a third of circle $5\frac{1}{2}$ inches in diameter ; the handle must be *well depressed* between the thighs. If retention occur, inject into the urethra cocain hydrochlorate gr. j in 3j of water and alcohol ; try, *with the patient lying down*, to pass a French coudée catheter ; if unsuccessful, use the over-curved gum elastic ; and if this fail, the prostatic silver catheter must be tried. When the instrument passes with difficulty, a vulcanised india-rubber catheter should be tied in. The sufferer should be kept in bed for three or four days, and have his bowels acted on by a calomel and colocynth purge. If the bladder be much distended, all the water it contains should not be drawn off at the first catheterisation, as a fatal syncope has supervened under such circumstances.

General Treatment.—Avoid sitting on

cold seats, exposure to cold, wet feet, strong emotion or excitement, sexual excess, spirits, riding, long railway journeys, or driving. The patient should wear flannel from head to foot, and have waterproof boots, such as those with soles of anhydrous leather. The best stimulants, when these are required, are light Rhenish wines or claret. Walking exercise in moderation is good. When there is frequent micturition at night, morphia or opium suppositories are of great service. I have found patients experience great benefit from the mineral acids, with small doses of opium and belladonna. Decoction of pareira brava, or infusion of triticum repens, is often useful. If the urine be acid, bromide of potassium in camphor mixture, and small doses of iodide of potassium. Keep the bowels regular by mild aperients, as cascara sagrada, senna, rhubarb, magnesia, manna, bitartrate of potash, sulphur, or some mineral water. In gouty patients vin. colchic. (mx), with iodide of potassium at bedtime.

Habitual Catheterisation by the patient must be performed twice or more often in the day, whenever the residual urine amounts to eight ounces, or when the patient is much disturbed at night and cannot rest. The precautions already mentioned must be carefully followed, until the patient be used to the presence of instruments, as continuous urinary fever is a common result on commencing catheter life, and may terminate fatally ; another unfavourable sequence is hæmorrhage from the kidney, followed by pyelitis and cystitis.

Advanced Prostatic Disease.—In these cases the patient's life becomes a burden to him, the bladder is intolerant of urine, and the catheter must be passed every hour or half hour. To afford relief to these miserable sufferers several methods have been suggested and executed.

Sir Henry Thompson recommends the following operation : A large hollow sound, having a well-marked curve, closed by a bulbous-ended stylet, is passed into the bladder until the end can be felt behind the symphysis pubis. This is held by an assistant. The surgeon then makes an incision three-quarters of an inch long, or less, in the middle line at the upper border of the symphysis.

The forefinger is inserted and the tissues separated. Next, with a bistoury, the linea alba is divided slightly, and the finger passed until the tip of the sound be felt distinctly; an incision is made on this large enough to allow the end of the sound to protrude in the wound. The stylet is withdrawn by the urethra, and a tube of elastic gum, $2\frac{1}{2}$ inches in length, with a silver plate, introduced in its whole length into the hollow channel of the sound; as the latter is withdrawn, the end and part of the tube is left in the bladder. The tube is fastened with tapes and plaster, and is worn continuously; all the urine passes through the tube. The patient must stay in bed for a few days after this operation.

Another method of affording relief is to make a perineal incision on a grooved staff, open the membranous part of the urethra, pass a narrow blunt gorget into the bladder, and insert an india-rubber tube to allow the urine to run away as formed, and retain it there for some eight weeks, or as long as may be necessary.

A third method is tunnelling the large prostate, as introduced by Reginald Harrison. He writes: "This may be regarded as the only treatment which hitherto has been immediately followed by shrinking of the large gland, and complete recovery." Gross writes of this plan: "My conviction is that this operation is destined to come into general use in this class of cases, of such frequent occurrence in advanced life, and a source of so much suffering." The operation consists in puncturing the bladder with a special trocar, about one inch in front of the anus. The trocar is intended to pass through the large prostate into the bladder at a lower level than that of the normal canal, the object being to make a temporary "low level" urethra, and thus to favour the thorough drainage of the viscus. When the bladder is largely distended with water the process is simple; when this is not the case the operation is performed as follows. The patient is anæsthetised, placed in the lithotomy position, a catheter passed, and the bladder distended with tepid water; the beak of the catheter is reversed so as to lie in the dip above the large gland, and the escape of water from the bladder is

prevented by a band round the penis. The trocar is introduced through the perineum into the bladder as already described. When the point of the trocar enters the bladder through the prostate, it will be found to strike the beak of the catheter, towards which it should be aimed. The trocar is hollow with an opening by the side of its point, so that as soon as the bladder is reached fluid escapes at the handle; the trocar is then withdrawn, and the canula left *in situ*. The catheter is fitted with a movable collar, so that by means of a screw the canula can be adapted to the thickness of the tissues penetrated, it not being desirable to leave too long an end of it within the bladder. The collar is perforated with side holes, by which the apparatus is fixed with a T-bandage; a piece of rubber tube is affixed to the canula to convey the urine to a receptacle.

After-treatment.—After a few days in bed, the patient is allowed to rise, and then hitches the end of the tube, fitted with a clip, into a belt round the waist. When he wishes to pass water, the tube is released, and the clip taken off. In six to ten weeks' time, when the urine flows by gushes by the urethra, the canula can then be removed, and the wound speedily heals. Harrison advises this procedure, firstly, in all cases of enlarged prostate accompanied by retention, where catheterisation is impossible; secondly, to induce atrophy of the prostate where the functions of the bladder are so interfered with as to render life almost intolerable.

A fourth method is to follow the steps pursued in lithotomy, and incise the prostate on both sides (prostatotomy). Lastly, McGill has removed portions of the large prostate with scissors through a supra-pubic operation.

Other Diseases of the Prostate.—Atrophy of the prostate may occur in old persons, in some malformations, and in exhausting diseases. There are no symptoms and no treatment.

Malignant Disease of the Prostate is rare, but may be sarcomatous or scirrhous. The symptoms are those of enlarged prostate rapidly increasing, severe pain, frequent hæmorrhages, disagreeable smell of the urine, and cachexia. The treatment is palliative.

Tubercle of the Prostate rarely occurs, and when it does so is secondary to

tubercle of the kidney, bladder, or testis. The prostate is enlarged, with symptoms of chronic prostatitis, and abscesses may form. There is a history of tuberculosis. Pus in the urine, frequency and pain in micturition, pains in the loin and perineum, cystitis, are present. No calculus can be detected on sounding. Treatment is that for tuberculosis (*vide* Tuberculous Orchitis).

Cysts of the Prostate are occasioned by dilated gland follicles of the size of a small pea, by abscesses, or by cavities containing concretions or calculi.

Prostatorrhœa is due to irritability of

the prostate, and is characterised by a discharge of viscid mucus from the urethra during defæcation or micturition. It may be mistaken for spermatorrhœa, but can be distinguished by the microscope.

Treatment.—Iron, nux vomica, removal of local irritation, as stricture, hæmorrhoids, fissure, etc. Sexual excess or masturbation must be prohibited. Applications of nitrate of silver by a syringe-catheter, blisters to the perineum, and the other measures recommended for spermatorrhœa (*q.v.*).

CHAPTER XXXVII.

DISEASES OF THE BLADDER.—LITHOTRITY.—LITHOTOMY.

Malformations.—The bladder may be absent, the ureters communicating with the urethra, rectum, or vagina. Two or more bladders may exist. The most common malformation is extroversion of the bladder (*ectopia vesicæ*); this consists in an absence of the anterior wall of the bladder, with the integuments covering it, and frequently of the pubic symphysis; the recti muscles are separated at the lower part, leaving a triangular gap. In some cases the whole of the hypogastric region is deficient from the navel to the pubes, and there is no umbilicus. There is often a hernia on one or both sides. By the pressure of the abdominal viscera the posterior wall and base of the bladder are pushed forwards, producing a round or oval, bright red, vascular, and papillated tumour, just above the pubes, which is liable to be mistaken for a nævus or malignant growth. The urinary tumour is small in the child, rarely exceeding a walnut; in the adult it is much larger; the size is increased when the abdominal muscles are contracted. The orifices of the ureters can be seen at the lower part as two small eminences, from which the urine constantly trickles. A small, imperfect penis projects from beneath the lower margin, and is cleft above in the median line, exposing the floor of the urethra (*epispadias*). The scrotum, though generally present, may be

altogether absent or rudimentary; the testicles present similar variations. The deformity is infinitely more common in the male sex; and though from the filthy urinous odour the patient is a nuisance to himself and those brought in proximity with him, it does not materially shorten life. As the result of the condition of the penis the sufferer is impotent.

Treatment.—This consists in covering in the exposed mucous membrane by a plastic operation, and wearing a proper urinal.

Wood's Operation.—A square flap of skin, with its base adjacent to and slightly larger than the upper margin of the opening, and sufficiently long to cover the bladder completely, is raised from the abdomen and turned down with the skin surface near the bladder. A pyriform flap is dissected up on each side from the groin, with its base equal in width to the length of the first flap, and directed downwards and inwards towards the scrotum and thigh, or downwards and outwards. These two flaps are then drawn across the reversed umbilical flap, meeting in the median line, the raw surfaces of the groin flaps and umbilical flap being in contact. The flaps are secured by hare-lip pins, including a portion of the thickness of the umbilical flap. The edges of the wound left by the removal of the flaps are brought together as much as possible by

hare-lip pins and wire sutures, and supported by broad strips of plaster. The patient is kept in bed with the knees drawn up. The sutures are removed at the end of a week. The fissured penis is covered in by raising the whole front of the scrotum, including the dartos and the skin covering the lower part of the penis; this is lifted over the penis, the surface being previously freshened, and united by a continuous suture.

Cystitis, or inflammation of the bladder, commences in the mucous membrane, and is met with in two forms, the acute and chronic.

Acute Cystitis. Causes.—Extension of inflammation from adjacent parts, as the urethra or prostate, or after operation on the rectum. Any irritation of the mucous lining of the bladder from calculi, foreign bodies, instrumental interference, tumours, retention and decomposition of urine, chemical irritants taken by the mouth, as eantharides, copaiba, turpentine, alcohol, etc., chemical irritants injected into the bladder. Trophic changes from defective innervation, the result of injury or disease of the brain and spinal cord, and it is probably in this way that cystitis occurs as a sequenee of the acute exanthemata. Exposure to cold with suppression of the cutaneous perspiration. Gout. Wounds or other direct mechanical injury of the bladder.

Pathology.—The whole mucous surface is rarely affected, but patches of irregular shape are red, swollen, and softened. Lymph may be poured out, and there is excessive formation of mucus, with detachment of the epithelium and abundance of young cells. In severe forms the mucous membrane may slough.

Symptoms are generally well marked. In the more severe forms arising from instrumental interference there are rigors, fever, thirst, dry tongue, sweating, frequent micturition, the urine being expelled in small quantities, accompanied by great pain and straining, and a scalding sensation at the neck of the bladder and along the urethra; tenesmus, vomiting, acute pain, swelling and tension in the hypogastric region, along the urethra, in the perineum, and sometimes in the sacrum, loins, groins, and thighs. The contracted bladder, forming a small, hard, round swelling, can be felt on slight pressure above the pubes, which causes ex-

quisite pain, and also by the finger passed into the rectum. The limbs are bent and drawn up, whilst the body is bent forward to relieve the abdominal muscles. The urine is high-coloured, alkaline, scanty, and clonded; then bloody, purulent, and loaded with shreds of vesical epithelium, and charged with urates and amorphous phosphates; it has a peculiar fetid odour. The patient may become delirious, or fall into a typhoid condition, followed frequently by death in from four to fourteen days. The fatal termination is due to implication of the kidneys, suppression of urine, and now and then to peritonitis or septicæmia. In the milder form, subsequent to urethritis or exposure to cold, the symptoms are frequent and painful micturition, supra-pubic pains, pains in the sacrum, perineum, and thighs, loss of appetite and feverishness; the urine is cloudy, with a muco-purulent deposit. The mucous membrane of the neck and base of the bladder are chiefly affected, and the termination is usually favourable.

Treatment.—A brisk mercurial purge, absolute rest in bed, leeches to the perineum, poppy fomentations, or laudanum and linseed poultices. Hot hip baths at a temperature of 100° Fahr., to 108° Fahr., for ten or fifteen minutes two or three times a day. Small doses of antimony, with liquor potassæ, tincture of hyoscyamus (5ss to 3j), infusion of jaborandi, in barley water or decoction of triticum repens. Barley water or linseed tea to relieve the thirst. If the skin be moist, Dover's powder is advantageous. When vomiting is troublesome, effervescing mixtures. To relieve irritability of the bladder suppositories of opium and hyoscyamus are very efficacious. A milk diet is the best. In severe forms give plenty of support and stimulants; morphia by the mouth or hypodermically; warm emollient enemata to relieve the bowels. Watch for retention or inflammation of the kidney. In gouty cases administer colchicum and carbonate of lithia.

Chronic Cystitis—Cystorrhœa, or Catarrh of the Bladder.

Causes.—It may follow the acute form, but is nearly always occasioned by some obstruction to the flow of the urine, as stricture, urethral or vesical tumours, enlarged prostate, urethral calculi, tumours of the penis. It may arise

from foreign bodies in the bladder, and calculi; abnormal states of the urine, as undue acidity, alkalinity, etc.; disease of neighbouring organs, as the anus, rectum, vagina, or uterus; renal disease; atony of the bladder; paralysis of the bladder; adhesion to the intestine or protrusion in a hernia; and lastly from the use of dirty instruments.

Pathology.—The mucous membrane is thickened and congested, and the muscular coat hypertrophied. In old-standing cases the bladder may be thrown into ridges (fasciculated), and sacculi may form as the result of projections of the bladder wall between the ridges. The sacculi, when small, are composed of the whole thickness of the coats of the bladder; when large, they consist only of mucous membrane and cellular tissue. They not unfrequently contain a calculus, and always mucus, pus, and decomposing urine. The lining membrane may be ulcerated, or covered with lymph; in some cases a deposit of pus occurs in the thickness of the bladder wall (abscess of the bladder).

Symptoms.—Simple chronic cystitis or irritability of the bladder is the least severe form, and is characterised by frequency of micturition, accompanied by spasm, pain, and an increased quantity of mucus in the urine. In the more severe form (vesical catarrh), the mucopurulent discharge is very abundant, thick, tenacious, semi-transparent, whitish, viscid, and glutinous; on standing, the discharge sinks and adheres to the bottom of the vessel containing the urine, and is poured out with difficulty; phosphate of lime or triple phosphate may be mixed with the mucus, forming white streaks. The urine is alkaline, from the urea being converted into carbonate of ammonia, brown or blackish in colour, and emits a fœtid offensive odour. If ulceration be present, hæmorrhage is common, the blood being mixed with the urine. The constitutional symptoms may be those of hectic fever, or a typhoid condition, or peritonitis. The disease is very fatal in the aged, intemperate, or where there is paralysis or renal disease.

Treatment.—Remove the cause, if possible. Pass a flexible catheter two or three times a day, and draw off the water. Wash out the bladder with a gum elastic catheter and an india-

rubber injecting bottle, Buckston Brown's bladder irrigator, the irrigating can, or india-rubber tubing with a funnel attached to the catheter, and used as a siphon; care must be taken not to inject more than an ounce without letting it run out. Warm water slightly carbolicised is a good injection, later on acetate of lead (gr. j to ʒiv), nitric acid (mij to ʒj), phosphoric acid diluted or acetic acid (miv to ʒj), glycerine of tannin (miv to ʒj), Barff's boro-glyceride (mxiij to ʒj), sulphate of quinine (gr. ij to ʒj), nitrate of silver (gr. ss—j to ʒj), peroxide of hydrogen, Collinsonia Canadensis, etc. Chlorate of potash (grs. v—x to fʒj.) is useful if the urine be putrid. If there be much pain, poultices of linseed and mustard to the pubes, and suppositories of morphia, or opium and belladonna; in some cases, a solution of morphia (gr. j), injected into the bladder, affords more relief than suppositories. Galvanism, one electrode on the perineum or in the bladder, the other on the lumbar spine; the strength of the current should be two and a half to five milliamperes, and the duration of the sitting ten minutes.

Internal Remedies.—Infusions or decoctions of triticum repens, alchimella arvensis, buchu, pareira brava and uva ursi, half a pint to a pint daily. Buchu and triticum repens may be used when inflammation is present, the others when there is no inflammation, but profuse discharge. Small doses of copaiba, cubebs, santal-wood oil, tincture eucalyptus, tincture cantharides, gurjun oil, Venice turpentine, oil of turpentine (mxx), quinine, tar capsules or tar water, are often of service. If the urine be acid, chlorate of potash (ʒss to O j) or liquor potassæ and hyoscyamus. When alkaline, benzoic acid, gallic acid, mineral acids with opium, lemon juice, and bismuth are advantageous. Dover's powder is often productive of benefit, in fifteen grain doses. The patient must avoid stimulants, tea, coffee, and cocoa; he should rest in bed, and keep his bowels regular. A strict milk diet is of the utmost value; the milk being iced or diluted with Vichy water. In obstinate cases the neck of the bladder should be opened (cystotomy), and a drainage tube be inserted, so that the urine may drain away as soon as it enters the bladder. When typhoid symptoms set in, stimu-

lants, bark, and ammonia, and full doses of opium or morphia by the mouth or rectum.

In *women* the local treatment is most important. The bladder must be washed out with slightly acidulated warm water, until it be clear of phosphates and mucus, and afterwards a solution of morphia should be injected. Later on, injections of permanganate or chloride of potash, and, as acute symptoms subside, injections of tannin or perchloride of iron, immediately followed by morphia, and finally nitrate of silver.

Hæmaturia is the passage of urine mixed with blood; if the blood be in large quantities the urine will appear bright red or dark brown; but if only a small amount be present, a smoky colour is produced. Blood corpuscles can be detected by the microscope; the colour disappears on heating, and albumen is precipitated. Spectroscopically, blood, even in minute quantities, will give two absorption bands, between the Fraunhofer lines D and E, in the yellow and green of the spectrum.

Causes.—Constitutional. Scurvy; purpura; malignant fevers; ague; the acute exanthemata; hæmorrhagic diathesis; endemic hæmaturia occurs in Brazil, West Indies, Mauritius, and Africa, and is due to the presence of a parasite (*bilharzia hæmatobia*); hæmaturia may be vicarious to suppressed menstrual discharge. In China it is due to the *filaria sanguinis hominis*.—Obstructive causes. Enlargement and induration of the liver, and abdominal tumours by pressure on the vena cava. Metallic poisons. Mercury, lead, arsenic.

Local.—Traumatic. External injury, affecting any part of the urinary tract, severe exertion, blows, strains, and laceration by a calculus.

Renal.—Congestion, acute nephritis, suppurative nephritis, cancer, tubercle, embolism, small calculi in the tubules, hydatids, etc. The hyperæmia induced by violent diuretics, as turpentine and cantharides. Movable kidney.

Ureter and Pelvis.—Cancer, tubercle, and parasitical diseases.

Vesical.—Cystitis, calculus, tumours, sudden evacuation of a chronically distended bladder, varix vesicæ, foreign bodies, ulceration.

Prostatic.—Congestion, hypertrophy, and tumours of the gland.

Urethral.—Chordee, rupture in sexual intercourse, stricture, gonorrhœa and urethritis, phagedæna, impacted calculus, tumours in the urethra, ulceration (in syphilis).

Diagnosis.—It is important to ascertain the source of the blood and its cause. "Swim out in water all clots whose origin is doubtful, in order that you may see the shape. Over and over again you find yourself able to diagnose the cause by this common-sense expedient" (Hilton).

Renal Hæmorrhage is frequently preceded or accompanied by some signs of kidney disease, as tube-casts, albumen, dropsy, and a history of renal affection. The blood is intimately mixed with the urine, giving it a smoky tint; if the urine be acid the blood is generally of renal origin, but the administration of alkalies or the presence of much blood or pus may make the urine alkaline. There is but little local pain. When produced by a calculus the symptoms of such will be present; if caused by malignant disease, there will be physical signs of the growth; if traumatic, there will be a history of injury.

Hæmorrhage from the Pelvis and Ureters.—In this form the blood is also generally intimately mixed with the urine, but there may be long vermiform coagula discharged.

Vesical Hæmorrhage.—Bloody urine, if alkaline, is generally of vesical origin. The blood is, as a rule, of a bright red or pink colour, and less closely mixed with the urine than in renal hæmorrhage; if due to cystitis there will be the symptoms of this disease; when caused by calculus, the symptoms and use of the sound will disclose the origin; the blood is bright, and increased by exercise. Should the blood originate from a tumour, it is in large quantities, irregular, and of a bright red colour or resembling coffee-grounds; severe pain is present, and a tumour may possibly be felt by examination above the pubes or per rectum; pus and shreds of the growth come away, and can be examined microscopically. In vesical hæmorrhage the urine first passed is often clear, the blood appearing at the close of the stream, when it may be pure.

Prostatic Hæmorrhage.—The blood is of a dark colour, and often retained in the bladder for some period, the urine being of the colour of porter; the blood occurs mostly with the last of the stream,

that first passed being pale or less blood-stained. The history of the case, age of the patient, and results of examination by the urethra and rectum must be considered.

Urethral Hæmorrhage.—The history of the case is important. The blood flows in a pure stream *independent of the discharge of urine*, and long slender clots may come away. If urine be passed, the blood may appear at the beginning and end of the stream, whilst the intervening flow is clear.

Treatment.—All constitutional causes must be treated on general principles. When renal, rest in bed; Leiter's coils to the loin; subcutaneous injection of ergotin; gallic or tannic acids; alum; lead; turpentine; infusion of matico (ʒij om. 4 h. s.); iron; sulphuric acid; tincture hamamelis; cupping; leeches; aperients; exclusive milk diet; packing in blankets wrung out of hot water; mustard poultices.

In vesical hæmorrhage—Opium; Ruspini styptic; ice-cold water injections in rectum, with ice-cap or Leiter's coils to the pubes; oil of turpentine (mx to xx); the remedies above mentioned for renal hæmorrhage. If the bladder be distended by a clot in a person who cannot pass urine by his own efforts, a full-sized catheter with a large eye must be passed, and a syringe or the stomach pump attached, or, preferably, the lithotomy aspirator, to enable the clot to be withdrawn. The clot may previously be softened by injections of pepsine into the bladder. When the clot is removed, injections of tr. ferri perchlor. (mxxx to ʒiv), or nitrate of silver (gr. j to ʒj) may be employed.

Vesical Tumours are classified by Sir Henry Thompson, to whom we owe the great part of our knowledge of this subject, into: 1. Mucous polypus, of the type of myxoma, only occurring in young children, rarely met with, generally multiple, growing rapidly and soon filling the bladder.

2. Fimbriated Papilloma, composed of mucous membrane developed into fine papillæ, consisting of long fimbriated processes of extreme tenuity, and usually forming a group rising from a circumscribed base. This growth is usually single. It consists of a connective tissue groundwork, covered by layers of cylindrical or spheroidal epithelium, each

papilla being provided with a considerable blood-vessel; in the deeper parts are bands of non-striated muscular fibre.

3. Fibrous papilloma is connected with the mucous and submucous tissues. The papillary processes, though present, do not form the chief part of the growth, which is chiefly solid and of a fibrous nature. A variety of this class is the fibro-myomatous, which springs generally from a wide base, is rounded in form, of small or moderate size, and firm in consistence. It is chiefly formed of unstriated muscular fibres, with some connective tissue; the muscular fibres are arranged in trabeculæ, which give off secondary trabeculæ, containing more or less muscular fibres. The growth is covered with columnar epithelium.

4. Transitional type, which have a dense fibrous groundwork of very irregular growth, with a large quantity of small nucleated cells interspersed with various irregular shaped cells.

5. Malignant. — Epithelioma, scirrhous, and round-celled or spindle-celled sarcomata. The disease may be primary or secondary to similar affection of the prostate, rectum, or uterus.

6. Dermoid tumours have been met with on a few occasions, but are extremely rare.

Symptoms. — Sir Henry Thompson writes: "Now the symptoms of vesical tumour present nothing special at the onset; a little undue frequency of micturition is then commonly the only sign. But early in the progress of papilloma there is an important sign, characteristic of it throughout its entire course, and common to most other tumours at a late period, namely the appearance of blood in the urine. A single hæmorrhage occurs after exercise, thus resembling that from calculus; hence its presence is often suspected, but with certain differences which you may advantageously note. First the hæmorrhage from papilloma is generally much more abundant than that of calculus; and secondly it is mostly unaccompanied by pain and irritation of the bladder. As the case advances, bleeding becomes more frequent; pain, however, is still rarely complained of unless obstruction to the outflow of the urine is occasioned by clots. Such a history should always arouse great suspicion" The blood is often passed at the end of micturition, the urine flowing

at the commencement being clear and natural, but becoming of a bright red colour towards the close. The *débris* of the urine must be carefully examined microscopically, and the bladder should be washed out through a small evacuating catheter, and the washings examined, with a view to detect the characteristic papillomatous fragments. The tumour is too soft to be felt by a sound. If a malignant growth be present a marked sign is bleeding into the bladder, occurring suddenly and in large quantities, irregular, disappearing, and then reappearing at intervals; the blood may be almost pure and of a bright red colour. Pain is generally severe; obstruction to the flow of urine common with symptoms of chronic cystitis. Pass a sound and examine per rectum and above pubes with this in the bladder, when a softish mass may be detected; on introducing the finger into the rectum, hardness, thickening, and inequality of the surface may be apparent. As the disease progresses, rapid loss of weight, cachexia, secondary implication of the lumbar and pelvic glands, and death from exhaustion.

Treatment.—In those cases in which a papillomatous growth is certain from microscopic examination of the *débris* of the urine, a suprapubic opening must be made in the bladder (*vide* Lithotomy). When the bladder has been thus opened, Sir Henry Thompson advises that the index finger should be inserted in the small orifice, checking the flow of water which has been previously injected. The left hand, still holding the hook with which the bladder coats were firmly fixed, is now removed. The finger in the bladder examines its wall, and ascertains the form, dimensions, consistence of the tumour, and the way it is connected with the mucous membrane; the rest of the inner surface is searched for other growths. The incision is dilated with the finger or prolonged with the knife, according to the requirements of the case. It is usual and often convenient to pass a long loop of stout silk, one on each side of the upper margins of the opening of the bladder, through its coats, that an assistant may, by drawing them apart, display the cavity, and at the same time preserve the opening in its place. The operator then applies a pair of forceps of appropriate form, sharp or blunt according to the nature of the tissues to be

removed, using the latter only whenever it is not possible to remove them with the blunt instruments. Sir Henry Thompson uses forceps with wide and serrated margins, of different patterns; one straight, resembling lithotomy forceps, others curved; a pair of each pattern has cutting edges for use when the growth is more firm and solid than usual. If the tumour do not come away with gentle efforts, the forceps are removed and the finger inserted, the growth being removed with the nail or serrated instrument. In other cases a small *écraseur* with a violin-string ligature is necessary. When the base is wide such parts of the tumour as can be safely removed are seized and destroyed in the same manner; if a thickened or hardened base be encountered it must be left; there should be no attempt to separate this from the coats of the bladder, with which indeed it is incorporated. When nothing remains to be dealt with, the fluid should be allowed to run out of the rectal bag, for the bleeding is usually rather free during the removal of the growth, taking away the pressure on the veins, the result of the bag, powerfully aids in checking it. There is no occasion to close the bladder, indeed it is better not to do so. Its muscular tissue soon contract and narrow the opening, which may moreover continue to give exit to a quantity of small tumour *débris* which remains; some of the bruised surface of the base left behind will slowly slough and separate. The wound is then treated precisely as after the suprapubic operation for calculus.

This is a brief account of Sir Henry Thompson's method of operation. Of thirty-eight cases in which he has operated, there has been no return in at least five, and perfect freedom from urinary troubles; in twelve cases sufficient time has not elapsed to test the permanency of cure; four patients died within a few days after the operation, from exhaustion, cystitis, and peritonitis; two died from blood poisoning on the twelfth day after the operation; several are living with threatening return, and the great majority obtained relief from symptoms and prolongation of life.

In a second class of cases the symptoms and history point to a tumour, but on careful examination no corroborative evidence is afforded by the microscope. For these, digital exploration of

the bladder is performed by Sir Henry Thompson in the following manner. After ether has been given, a median staff with a short curve, wide, and deeply grooved, is passed into the bladder and held by an assistant, the patient being then tied up in the lithotomy position. The surgeon being seated introduces into the rectum his left forefinger, and recognises the grooved staff, and the apex of the prostate, against which the tip of the forefinger is kept. With a long, narrow, straight-backed bistoury a vertical incision is made through the skin and cellular tissue in the middle line, about $1\frac{1}{4}$ inches long, the lower end of the incision finishing about three-quarters of an inch above the anus. The bistoury is next entered, with the cutting edge upwards, in a horizontal direction, at the lower part of the incision just above the upper border of the bowel and parallel with it, and the point directed inwards, until the membranous part of the urethra be reached and punctured, the knife entering firmly the groove of the staff. Contact being distinct, by a to and fro movement of the knife the urethra is incised for a few lines, and the bistoury then withdrawn, cutting the tissues slightly upwards. A tapering gorget-like director is passed along the groove of the staff, along the urethra to the bladder, and the staff withdrawn, the director retained in place by the right hand, the left index finger is gently introduced into the bladder along the director, which is then withdrawn. With the right hand firm pressure is made above the pubes, so that all the surface of the bladder is brought in contact with the exploring finger, and the presence of a tumour, its size and shape, etc., ascertained. If no tumour be present a stout india-rubber tube, six inches long, with lateral as well as terminal openings, is passed through the wound, and retained for a few days, with one end just in the bladder. Should a single polypoid growth be found it can be easily removed by forceps through the existing opening. Should the best course be removal by a supra-pubic incision, it should be at once performed, as the perineal opening does not in the least interfere with this line of action; the rectum is to be distended in the usual way, and the bladder will retain the usual injection in spite of the existing opening.

In malignant growths no operation by the knife is advisable. To restrain bleeding, alum or iron-alum (gr. x to xv) with sulphuric acid (mxx), or infusion of matico (ʒij) should be given every two hours; injection of nitrate of silver (gr. j to ʒiv); absolute rest in bed. Opium or morphia in sufficient quantity to relieve pain.

Atony of the Bladder arises from overdistension, the bladder being unable to expel its contents from deficient muscular power.

Causes.—Hypertrophy of the prostate; stricture of the urethra; stone, or tumour of the bladder; long-continued retention of urine, either voluntary or from spasm; affections of the brain; fevers, or any long illness; habitual distension of the rectum, or colon; and pressure of the gravid uterus, etc.

The muscular fibres, being greatly stretched, are weakened and not sufficiently powerful to pass all the urine, the result being that a varying amount of residual urine is left behind in the bladder. As the residual urine increases in amount, it overcomes the resistance of the sphincter, and there is "overflow" or dribbling of a portion of the urine during sleep, or when strong muscular efforts are made. It is important to remember that *involuntary micturition is generally a symptom of retention*, or the true nature of the case may be overlooked.

Symptoms.—The stream is delayed and feeble, the termination of the act lacking force; increased difficulty in micturition, appearing gradually or suddenly in cases where the patient has been obliged to hold his water over long. Swelling over the pubes, which may reach as high as the umbilicus, and laterally to the brim of the pelvis; dulness on percussion; on passing a finger into the rectum, and pressing with the other hand over the pubes, fluctuation can be detected. If a catheter be introduced, the residual urine can be drawn off, and the diagnosis confirmed. Cystitis is apt to occur.

Treatment.—Withdraw the urine by a soft catheter three or four times a day, and wash out the bladder. It is advisable the first time the water is drawn off, not to use too large a catheter, nor evacuate all the urine at once, for fear of hæmorrhage into the bladder, or syncope. Berkeley Hill writes: "A common result after the abstraction of large collections

of urine, is subacute cystitis, pyelitis, and fatal nephritis, due, it is believed, to the sudden removal of pressure from the kidney, and to the introduction of sepsis by the use of unpurified instruments." Electricity, with one rephore over the pubes and one in the bladder, the galvano-faradic current being very useful. Cold douches, iron, cantharides, strychnia, ergot, arnica, and nitro-muriatic acid, are the best internal remedies. Blisters over the lumbar or sacral regions. Even after patients have recovered a fair amount of power over the bladder, some residual urine will often remain, and must be drawn off.

Paralysis of the Bladder is due to some deficiency, or impairment of its nerve supply, as the result of changes in the nervous centres, occurring from injury of the brain or spinal cord, or from disease of these parts; in cases of severe shock; in cases of hysteria; subsequent to sexual excess; in cases of fever. A second class of cases is reflex, and the consequence of operations, injury or disease of adjacent parts, as amputation of the thigh, ligature of hemorrhoids, child-birth, etc. Thirdly, certain drugs, especially belladonna and hyoscyamus, will occasion paralysis of the bladder.

Symptoms are similar to those of atony of the bladder, but in addition there are often symptoms of disease of the nervous centres, as loss of movement, sensation, etc. Cystitis is exceedingly common.

Treatment.—This is similar to that employed for atony. Gross writes: "In a very obstinate case resisting every known method of treatment, both general and local, for ten weeks, relief was speedily effected by injections of strychnia. The proper dose of the article when thus administered is from one-sixth to one-fourth of a grain, dissolved in two ounces of tepid water, and repeated every twenty-four hours."

Incontinence of Urine, or involuntary discharge of urine, occurs in children and adults.

Juvenile Incontinence is met with at any age below puberty, the child wetting the bed every night during sleep. It presents itself in nervous, excitable children, and in the dull and stupid. It may be due to carelessness, fear of darkness, or wilfulness, but is frequently reflex, from undue sensibility of the

urinary organs, the result of masturbation, phimosis, unnatural smallness of the urethral orifice, calculus, worms, gastro-intestinal derangements, and abnormal conditions of the urine, as undue acidity.

Treatment.—A nourishing diet, dry or wet cupping or blisters to the nape of the neck, little liquid during the latter third of the day, change of air, sea bathing, cold douche, avoidance of the dorsal position during sleep, and waking the patient during the night in order to pass water. The best internal remedies are: tr. belladonnæ (m x to xx t.d.s.), tr. hyoscyami, nux vomica, cantharides, copaiba, bromides of iron and zinc, chloral, tr. gelsemini, santalin. Corrigan closed the preputial orifice with collodion. Galvanism is often of great service, one pole being applied to the perineum, and one to the lumbar spine; a current of $2\frac{1}{2}$ to 5 milliampères being applied for ten minutes duration; in obstinate cases the negative pole may be attached to an intra-urethral electrode. In debilitated subjects, iron, iodide of iron, quinine, the mineral acids, cod-liver oil, and fresh raw arterial bullock's blood are useful. Opium in some cases, especially in the form of Dover's powder, has a beneficial influence. Any accompanying disease, as worms, phimosis, or calculus, must be treated, and the state of the digestive organs attended to. Reginald Harrison writes: "There is a form of irritability of the bladder which is frequently met with, especially in highly intelligent and sensitive children, at about the age of ten or twelve years, when they are entering on the sterner forms of educational study. On examination of the urine, it will be found loaded with phosphates. In remedying this condition, bromides in combination with opium will be found invaluable. The following is a formula I frequently employ for this purpose:—

R Ammon. bromid. ʒj
Mist. acaciæ ʒj
Quin. sulph. (neut.) gr. xij
Liq. opii sedativ. ʒss
Aq. ad. ʒvj.
M. ʒss t.d.s.

I have found in many cases it is better to omit the quinine from this prescription, and give instead two drachms of tincture hyoscyami.

Incontinence in the Adult is generally due to habitual engorgement of the

bladder and overflow of urine, and is *thus a symptom of retention* due to stricture, enlarged prostate, cystitis, calculus, atony, or paralysis. In the female it may be due to injury of the urethra, as pressure of the foetal head during labour; it is a very common occurrence also in chronic bronchitis during fits of coughing. Occasionally true incontinence is met with in the male as the result of nervous causes, hysteria, sexual excesses, reflex action; abnormal conditions of the urine, as excess of uric acid, oxalates, or phosphates.

Treatment must be directed to the disease on which it depends; when functional, give quinine, ergot, zinc, strychnia, iron, and the above-mentioned remedies. Hypodermic injection of strychnia is useful. Suppositories of belladonna and opium. A solution of nitrate of silver applied to the urethra and neck of the bladder. In hysterical girls, iron, valerian, and the bromides, with cold douching and a blister to the sacro-lumbar region; it is important to avoid catheterisation, or the patient will not attempt to pass water without it. Galvanisation is as serviceable here as in juvenile incontinence.

Calculus, or Stone, is either the result of constitutional causes or abnormal states of the system, termed diatheses; or secondly, it may have a local origin, being due to disease of the bladder.

Uric Acid Diathesis is often hereditary, and occurs in florid and robust persons, and is associated with gout or dyspepsia. Golding Bird arranges the causes of the formation of uric acid deposits thus: 1. The waste of tissue being

more rapid than the supply, as in fevers, rheumatism, etc. 2. The supply of nitrogen in the food being greater than is required for the reparation of the tissues, as in over-indulgence, especially in the use of animal food. 3. The process of digestion being insufficient to assimilate an ordinary and normal supply of food, as in dyspepsia. 4. Obstruction to the cutaneous outlet for nitrogenised secretions, as met with in diseases of the skin, variability of climate, etc. 5. Congestion of the kidneys from injury or disease. Murchison believed that an excess of uric acid was formed in the liver and passed into the blood with the re-absorbed bile. Latham refers the formation to the non-transformation or metabolism of glycocin into urea, whether the glycocin be derived from the bile poured out into the duodenum, or found elsewhere in the body. Frerichs and Wohler consider the formation of uric acid to be an intermediate stage in the conversion of albuminoid substances into urea, and that its presence in undue quantity is due to arrested oxidation.

Condition of the Urine.—The urine is very acid, cloudy, high-coloured and scanty; on cooling it deposits a yellow and red sediment. The yellow consists of uric acid, forming urates in combination with soda, potass, lime, and ammonia. The red is due to the presence of pupurine. The sediments *disappear on boiling*. The crystals composing them may coalesce, forming red sand resembling cayenne pepper, or appear in larger masses the size of a pea, a condition which is termed gravel.

(1) TABLE FOR THE MICROSCOPICAL EXAMINATION OF URINARY DEPOSITS
(DR. GOLDING BIRD).

1.	Deposit amorphous, and disappears on the addition of liq. potass.	= Urates.
2.	" and is permanent	" = Phosphate of Lime.
3.	" visibly crystalline, and the crystals octo-hedral.	" = Oxalate of Lime.
4.	" " " hexagonal tables sol. in ammonia.	} = Cystine
5.	" " " prismatic or penniform, insol. in ammonia, sol. in acetic acid.	
		} Neutral triple phosphate.
6.	" " " radial or foliaceous, insol. in ammonia, sol. in acetic acid with effervescence.	
		} Carbonate of lime.
7.	" " " radiated or foliaceous, insol. in ammonia, but sol. in acetic acid without effervescence.	
		} Bibasic triple phosphate.

MICROSCOPICAL EXAMINATION OF URINARY DEPOSITS (*continued*).

8.	Deposits visibly crystalline, and the crystals dumb-bells, insol. in ammonia, sol. in acetic acid with effervescence.	Carbonate of lime.
9.	" " " dumb-bells, sol. by heat, but not in ammonia or acetic acid.	Lithate of soda.
10.	" " " dumb-bells, insol. by heat, ammonia, or acetic acid.	Oxalurate of lime.
11.	" " " dumb-bells, with fringed edges, insol. in alcohol and acetic acid, but sol. in liq. potassæ.	Uric acid.
12.	" " " lozenge-shaped or compound, insol. in acetic acid and ammonia.	Uric acid.
13.	" " " spherical, with or without spicules, sol. by heat.	Urate of soda.

(2) TABLE FOR DISCOVERING THE NATURE OF URINARY DEPOSITS BY CHEMICAL REAGENTS.

1.	Deposit white and sol. by heat	. = Lithates
2.	" " and insol. by heat, but sol. in ammonia	. = Cystine
3.	" " " and ammonia, but soluble in acetic acid	Earthy phosphates.
4.	" " " and ammonia and acetic acid	Oxalate or oxalurate of lime.
5.	" coloured and visibly crystalline	. = Uric acid
6.	" " and amorphous, but pale and readily sol. by heat.	= Lithates.
7.	" coloured deeply, amorphous, and slowly sol. by heat	Lithates stained with purpurine.

Calculi of this diathesis are either uric acid or urate of ammonia.

Uric Acid Calculus. Physical Characters.—Small, or of moderate size; flattened oval in shape; of a fawn colour; smooth on the surface, or elevated into small tubercles; hard and heavy; on section it is laminated or radiating. It is of common occurrence.

Chemical Characters.—It becomes red on the addition of nitric acid; soluble in carbonate of potash, evolving no ammonia; soluble in caustic ammonia or potash; on the addition of an excess of acid crystallises in angular crystals; not soluble in water; gradually consumed before the blow-pipe.

Urate of Ammonia Calculus is very rare.

Physical Characters.—Soft and brittle; smooth, or slightly tuberculated; of a clay or slate colour; composed of concentric rings, which present a very fine earthy appearance when fractured;

rarely exceeds an inch. It occurs almost always in young children.

Chemical Characters.—It becomes red on the addition of nitric acid; soluble in carbonate of potash, evolving ammonia; soluble in water when boiled; solution in water with a few drops of ammonia, on evaporation crystallises in needles; gradually consumed before the blow-pipe.

Treatment.—As the chief causes are over-indulgence in animal food, mal-assimilation, and defective oxygenation of the blood, it is by attention to the diet, and the skin and bowels that this state is best treated. Alcohol; sugar in any form; tea; coffee; all kinds of pastry; new bread; and oily or fatty matter, as butter, cream, or milk, must be avoided. Boiled fish, oysters, chicken, and veal, may be used. The patient must take regular outdoor exercise. The skin must be kept freely acting by baths and friction. Hard water is to be

avoided, but the patient may drink freely of filtered rain-water, either hot or cold. Both summer and winter flannel must be worn. It is of great importance to maintain a healthy action of the bowels by pil. hydrarg. gr. $\frac{1}{8}$, with pil. rhei co. gr. iv, every other night; or cascara sagrada; or sulphate of soda with sulphate of magnesia; or tartrate of soda ζ in decoct. aloes co. ζ jss. The best aperients for those who can afford them are the natural mineral waters, as Friedrichshall ζ viij to x in a little hot water, or Hunyadi Janos ζ iv. With these aperient waters, which may be lessened in quantity, or increased, according to their effect, the patient should drink Carlsbad or Vichy. The best drugs are colchicum, benzoate of soda or ammonia, iodide of sodium, salicylates, guaiacum, arsenic, and sulphur. The salts of sodium, lithium, potassium, ammonium, calcium, and magnesium. Opium, hyoscyamus, and lupulin, are often very useful. In some cases nitrohydrochloric acid, diluted with a vegetable bitter, is of much service if a tonic be required.

Oxalic Acid Diathesis is characterised by the formation of oxalate of lime in the urine. It is associated with mal-assimilation and nervous exhaustion, and is thus met with in depression from grief, loss of blood, overwork, malaria, mental anxiety, venereal excess, and injuries of the spinal cord, brain, or spinal nerves. Certain articles of food, as tomatoes, rhubarb, etc., and the sparkling wines, will produce its appearance in the urine. The patient is pale, suffers from dyspepsia, insomnia, and hypochondriasis; there may be pain in the loins and loss of sexual power. The urine is pale, acid, and abundant, but contains no sediment. Crystals transparent, octohedral, or dumb-bell.

Calculus.—Oxalate of lime or mulberry calculus.

Physical Characters.—Colour very dark brown, almost black; surface rough, with large tubercles like a mulberry, or rugged and spinous; consistence, intensely hard; on section, imperfectly laminated; size seldom exceeds a walnut; shape, round.

Chemical Characters.—Not destroyed by heat; soluble in the mineral acid without effervescence: solution in acid when neutralised gives a white precipitate

with carbonated alkalies and oxalate of ammonia; insoluble in acetic acid, liquor potassæ, or ammonia; when boiled with carbonate of soda, oxalate of sodium is formed in the solution, and can be precipitated by chloride of calcium.

Varieties.—Besides the usual form, three varieties are met with: 1. *Hemp-seed calculus.*—Small, round, or oval, perfectly smooth stones, generally multiple. 2. *Unmixed crystalline oxalate of lime*, almost devoid of cementing material, and crumbling to pieces on drying or pressure. 3. *Snow-white oxalate of lime*, which is only met with in the kidney.

Treatment.—All vegetables and fruits containing oxalic acid must be avoided, as rhubarb and tomatoes; also those which are rich in malic, citric, or tartaric acids. Abstention from sugar, sugar-forming food, or alcohol. A fish diet is the best, and plenty of distilled water. Tonics, as the mineral acids, acid phosphate of soda, iron, zinc, quinine. Capsicum and hyoscyamus are of service. Galvanic current to the stomach and spine. Change of air to a warm and equable climate.

Phosphatic Diathesis occurs in anæmic, old, broken-down persons. It is associated with great disturbance of the digestive organs. Other causes are organic disease of the bladder and kidney, fatigue, over-exertion, mental worry, unwholesome food, debilitating medicines, excessive venery, injury to the spine. The urine contains either: (a) Triple phosphate, consisting of phosphate of ammonia and magnesia. It usually occurs in minute white crystals, transparent or opaque, of a brilliant appearance, with sharp angles and edges. Great diversity of form is met with, the most common being right rhombic prisms, penniform, radiated, or foliaceous crystals. They sometimes form a film on the surface of the urine. The urine containing them is pale, acid, very copious, of low specific gravity, and precipitates the deposit on the application of heat. It soon decomposes, or becomes dark and alkaline. (β) Phosphate of lime, which forms an amorphous whitish, greyish, or drab powder. The urine is pale, copious, of low specific gravity, offensive, and mixed with mucus. (γ) Mixed phosphates, consist of the two preceding varieties, and are formed in the bladder in cases of prostatic disease, spinal disease, or injury, etc. It forms a

white thick sediment, and is usually combined with thick, ropy mucus. The urine is offensive, pale, and copious.

Calculi.—Triple phosphate or ammoniaco-magnesian phosphate. This is rare.

Physical Characters.—White shining crystals, or a white crust radiating from a centre, with the surface studded with crystals; transparent when fresh, afterwards opaque like chalk; soft and earthy.

Chemical Characters.—Soluble in hydrochloric acid, and does not effervesce either before or after heating. The solution in acid, with excess of ammonia, gives a white crystalline precipitate. Dissolves in acetic acid without effervescence. Is insoluble in caustic potash or ammonia. With half its bulk of bone-earth it is very fusible before the blow-pipe, giving off an ammoniacal odour.

Phosphate of Lime or Bone-Earth Calculus.

Physical Characters.—When of renal origin, pale brown in colour; smooth surface, like porcelain; loosely laminated in structure; shape generally oval and size small. It is of rare occurrence. When formed in the bladder it presents itself in irregular masses, like mortar, or a granular semi-crystalline powder enveloped in a tenacious mucus.

Chemical Characters.—Soluble in hydrochloric acid, and does not effervesce either before or after heating; solution in acid with excess of ammonia gives an amorphous precipitate; with twice its bulk of phosphate of ammonia and magnesia it is very fusible before the blow-pipe.

Mixed Phosphates—Fusible Calculus or Mixed Calcic and Ammonio-Magnesian Phosphates is the most common of all phosphatic calculi, and consists of three salts: phosphates of lime, magnesia, and ammonia. It constitutes, it is believed, about one-twelfth of all calculi.

Physical Characters.—Colour, white, like chalk; shape, that of the cavity in which it lies; size, often very large; structure, laminated or compact and friable. It is common as an incrustation of foreign bodies introduced into the bladder.

Chemical Characters.—Soluble in hydrochloric acid, and does not effervesce either before or after heating; the solution in acid, with excess of ammonia, gives a white, partly crystalline, partly

amorphous precipitate. Very fusible, before the blow-pipe, into an enamel-like or glassy material.

Treatment of this diathesis consists in improving the digestive functions by a carefully regulated diet and suitable aperients. Moderate exercise in the open air. Dilute nitro-hydrochloric acid with opium is very useful. Tonics, as perchloride of iron, nux vomica, etc. The administration of raw arterial bullock's blood, as introduced by Dr. Abrath, is very serviceable.

Other Calculi, of rare occurrence, are carbonate of lime, cystine, and xanthine.

Carbonate of Lime is of very infrequent appearance.

Physical Characters.—Of small size, rarely exceeding an almond; round and flattened; light brown; compact and lamellar in structure, and very hard. Generally multiple.

Chemical Characters.—Not destroyed by heat; soluble in hydrochloric acid, and effervesces before heating; soluble in the other mineral acids, with effervescence; solution in acid, when neutralised, gives a precipitate with the carbonated alkalies and oxalate of ammonia; soluble in dilute acetic acid, with effervescence.

Cystine or Cystic Oxide Calculus is a rare form, containing 26 per cent. of sulphur.

Physical Characters.—Round and smooth, or covered with small tubercles or sharp projections; yellowish or greenish in colour; semi-transparent, waxy, and glistening; soft; imperfectly radiated in structure.

Chemical Characters.—It does not become red on the addition of nitric acid; soluble in ammonia, crystallising when evaporated in six-sided plates; soluble in strong caustic potash, the solution when boiled for a few minutes, on the addition of a drop of dilute acetate of lead, gives sulphide of lead.

Xanthine, Xanthic Oxide, or Uric Oxide Calculus is extremely rare, having only been met with in three recorded cases.

Physical Characters.—Hard in consistence; flattened oval in shape; generally small in size; colour, partly bright brown, and partly of a flesh tint; structure laminated.

Chemical Characters.—Does not become red on the addition of nitric acid; soluble in ammonia, not crystallising

when evaporated, and insoluble in carbonate of potassium; dissolves, without effervescence, in nitric acid, leaving a lemon-coloured residue; soluble in strong sulphuric acid, and not precipitated by dilution.

TABLE OF THE PHYSICAL CHARACTERS OF URINARY CALCULI.

NAME.	SHAPE.	COLOUR.	CONSISTENCE.	SIZE.	WEIGHT.	SECTION.
1. Uric acid.	Flattened oval; smooth on surface or covered with small tubercles.	Fawn.	Hard. Fracture crystalline.	Small or moderate.	Heavy.	Laminated or radiating.
2. Urate of ammonia.	Ovoid, smooth or slightly tuberculated.	Clay.	Soft and brittle. Fracture earthy.	Rarely exceeds one inch.	—	Homogeneous; sometimes laminated.
3. Xanthine or uric oxide.	Flattened oval.	Partly light brown and partly flesh colour.	Hard. Fracture not crystalline.	Small.	—	Laminated.
4. Cystine or cystic oxide.	Round and smooth, or covered with small tubercles or sharp projections.	Yellow or greenish, semi-transparent, glistening.	Soft. Fracture crystalline.	Small.	—	Imperfectly radiated.
5. Oxalate of lime or mulberry calculus.	Round but rough, with large tubercles like a mulberry.	Very dark brown, almost black.	Intensely hard. Fracture crystalline.	Seldom larger than a walnut.	Very heavy.	Imperfectly laminated in irregular wavy lines.
6. Triple phosphate or ammoniaco-magnesian phosphate calculus.	Irregular; surface studded with crystals.	Transparent when fresh, afterwards opaque white.	Soft and earthy, or fracture may be crystalline.	Generally large.	—	Imperfectly laminated.
7. Phosphate of lime or bone, earth calculus.	<i>Renal origin.</i> —Smooth, spheroidal, like porcelain. <i>Vesical origin.</i> —Irregular masses, like mortar or a granular semi-crystalline powder enveloped in mucus.	—	—	Large.	—	Loosely laminated structure.
8. Mixed phosphates, fusible calculus, or mixed calcic and ammonio-magnesian phosphates.	That of the cavity in which it lies.	White, like chalk.	Very friable or pulverescent or moist like chalk.	Large	—	Laminated, semi-crystalline or amorphous.
9. Carbonate of lime.	Round and flattened.	Light brown.	Very hard, but sometimes soft and friable.	Small.	—	Laminated.

General Characters of Calculi.—Structure. Most calculi consist of a centre or nucleus, a body or intermediate part, and a crust or outer coating. When these are composed of the same chemical substance, the calculus is termed Uniform or Simple; when made of two or more chemical substances, the calculus is said to be Mixed, Heterogeneous, or Compound; if the stone be made up of different elements, succeeding one another in regular layers, the name Alternating is applied. The nucleus most frequently consists of uric acid, next of oxalate of lime, and rarely of phosphates; the stone is classed

in accordance with the composition of its nucleus. The nucleus, as a rule, occupies the geometrical centre of the calculus; but, as a rare event, it is eccentric, or there may be several distinct nuclei. In a few instances calculi have no nucleus, the centre being occupied by a space; inspissated mucus, lymph, hair, blood-clot, or a foreign body, may serve the purpose of a nucleus. The calculous matter may have a continuous arrangement, but is usually deposited in concentric layers or laminæ, and sometimes in lines radiating from a centre; lamination depends on varying states of the

urine. A calculus with a uric acid nucleus generally has a body of urates, with often a crust of phosphates; an oxalate of lime nucleus usually has a body of the same substance, and may be crusted with phosphates; when the nucleus is phosphatic the rest of the calculus is of the same substance. The chemical constituents of the stone are held together by a kind of cement, which is believed to be derived from animal matter, either mucus, fibrin, or fatty matter; perhaps blood, epithelial scales, or even pus.

Origin.—When arising from some diathesis due to mal-assimilation, the calculus or nucleus of a calculus is formed in the kidney, of which the most common examples are uric acid and oxalate of lime. When occasioned by the presence of a foreign body in the bladder, as a pin, straw, etc., or due to stagnation of the urine in the bladder, the calculus, which is phosphatic, is of vesical origin.

Number varies: the renal are generally two or more; the vesical, one, but occasionally numerous; the prostatic many.

Volume ranges from a pea to a cricket ball, and depends greatly on the chemical composition, the phosphatic being the largest. The duration of the ailment has a great deal to do with the size.

Weight differs, from a few grains to several ounces, and depends on the chemical composition; the phosphatic are very light, the oxalates heavy. Most calculi are under an ounce. A stone will weigh more at the time of its extraction than it will a few days afterwards, owing to the loss of weight from evaporation.

Shape presents great differences: the vesical are generally oval; the uric acid and urate of ammonia are smooth and regular; oxalates, tuberculated globular, or square-shaped; phosphatic, irregular and contorted.

Consistence.—Phosphatic, soft; uric acid, hard and brittle; oxalates, very hard.

Situation.—Calculi generally lie loose in the bladder, but may be contained in a pouch in the bladder wall (encysted), fixed in the urethra, or deposited on and enclosed in a fungoid tumour.

Influence of Age.—Most cases of calculi occur from fifty-five to seventy-five, in proportion to the existing population at this age; the next most common period is below puberty; whilst, although

met with, it is comparatively rare in middle life. Gross, in his "Treatise on the Urinary Organs," gives the ages of 6,042 cases of stone in the bladder; of which 2,334 were observed from the first to the tenth year, 1,079 from the tenth to the twentieth, 513 from the twentieth to the thirtieth, 353 from the thirtieth to the fortieth, 422 from the fortieth to the fiftieth, 536 from the fiftieth to the sixtieth, 587 from the sixtieth to the seventieth, 201 from the seventieth to the eightieth, and 17 from the eightieth to the ninetieth.

Sex.—More common in the male than the female, in the proportion of one to twenty.

Station.—It is most frequent in the children of the poor, and in persons past middle life who are in affluent circumstances.

Climate and Locality.—It is more common in humid and moist countries of moderate and changeable temperature, such as Holland, France, England, and Germany. It is frequent in Egypt, Isle of France, Bagdad, Russia, India, and the West Indies. In some parts of a country it may be more prevalent than in others, as in Norfolk in England, and the North and North-Eastern parts of Scotland. In America, the States of Kentucky, Virginia, Ohio, Missouri, Alabama, Maryland, Indiana, Pennsylvania, and Tennessee, are those in which stone is most common. In Central Russia it is more common than in other parts of that country. In China, stone is confined almost exclusively to the province of Canton. The negro race rarely suffers from stone. It is said, and, as far as my experience goes, truly, that sea-faring people are remarkably exempt from stone in the bladder.

Symptoms.—1. *Frequency of Micturition*, increased especially during the day and on active movement, but less at night. 2. *Pain* at the lower part of the glans penis during and after passing water, as the stone is then in contact with the bladder. The pain may be referred to more distant parts, as the inner side of the thighs, testicles, and feet. Children constantly pull the prepuce to relieve pain, and this gives rise to an elongated condition. The pain is increased by any jolting movement, as walking, riding, driving, or jumping, etc. 3. *An altered state of the urine.*—The

urine contains pus and mucus as the result of accompanying cystitis. 4. *Blood in the urine.*—Hæmaturia is generally present at some time after active motion, but the quantity is small. 5. *Interruption to the flow of urine*, which stops suddenly, owing to the stone being washed forwards, and closing the urethral orifice at the neck of the bladder. 6. As the result of the irritation of a calculus, erections of the penis, prolapsus ani, retraction of the testicle, hæmorrhoids, and tenesmus may be present.

Physical Signs. Sounding for Stone.—The sound should have a small, short beak and a cylindrical handle, as recommended by Sir Henry Thompson. The patient should first have an enema to empty the rectum, and the urine should be previously examined to ascertain the state of the kidneys. The patient being recumbent, with the buttocks raised by a pillow, if a child, an anæsthetic is administered; this measure, although not indispensable, being also very useful in adults. The bladder should contain an ounce or two of fluid.

Introduction.—The operator stands on the right side of the recumbent patient, holding the sound, well oiled and warmed, in his right hand; he inserts the beak into the meatus and draws the penis along the sound for four inches, the sound being gradually raised into a vertical position. The instrument must be introduced with the utmost carefulness and gentleness, slowly allowing it to glide along the canal by its own weight until it slips beneath the pubic arch, when the handle must be depressed between the thighs. Having reached the bladder, the beak is turned towards the back of the bladder, and gently moved from side to side; it is then drawn forward on the right side, and then on the left; lastly, the handle is raised, and the base of the bladder examined. Large calculi are generally found near the neck of the bladder and on the right side; small and medium-sized lie at the base to the right or left. If the stone cannot be detected, the handle of the sound must be raised with the beak downwards, as the calculus may be lodged in a pouch behind the prostate. Should no stone be found, the patient may be examined standing, water may be injected into the bladder, and a finger in the rectum with

an assistant's hand pressing gently above the pubes will aid in the examination. *When a stone is struck by a sound a distinct sensation is felt, and a corresponding sound heard.* Patients should not be sounded until prepared for the operation by previous rest in bed, attention to diet, etc.; nor should they be allowed to travel any distance immediately before or after the operation, confinement to bed in a warm room for at least a day being an essential condition of safety.

Sounding enables the surgeon not only to detect the presence of a stone, but to ascertain the size, situation, number, and density.

The size is best determined by using Sir Henry Thompson's sound, which has a metallic collar sliding along a graduated shaft. The sound is carefully moved just beyond the distal end of the calculus, the collar is slipped down to the meatus; the sound is now carefully withdrawn, tapping the stone until the proximal end is reached; the distance of the collar from the meatus will mark the diameter of the stone. Another plan is to seize the stone with the blades of a lithotrite.

The situation.—Whether the stone be loose and free, or fixed and encysted, can be proved. If encysted the sound strikes the calculus at times, but not at others; the stone is always found at the same place; the beak cannot be passed round it.

The number can sometimes be perceived by the sound, but it is advisable to use a lithotrite, seize the stone, and then search for more.

The density.—Phosphatic calculi give a dull note; uric acid a clear, ringing, metallic resonance. When grasped by the lithotrite the phosphatic is gritty, but easily yielding; the uric acid hard, but yields on pressure; the oxalate of lime very hard and unyielding.

Errors in Sounding.—These are two-fold: 1. Failure to recognise a stone although present; 2. Detection of a stone when the bladder does not contain one.

1. Failure to recognise a stone, though this be present, may arise from it being coated with an imperfectly organised leather-like substance which conceals it from detection by the sound (Harrison). In enlarged prostate, if the surgeon be not careful he may not reach the bladder with the sound; the bladder being at a

great distance, when the sound is in the prostatic sinus, from the depth the instrument has reached and its being movable from side to side, the operator may consider it is in the bladder. To avoid this, the patient's hips must be well raised, and the sound greatly depressed between the thighs, a rotatory motion being employed. Should this be unsuccessful, a sound with a large curve should be used. Another source of error is introducing the sound too quickly and without rotation, and thus passing the stone as it lies at the neck of the bladder. If the stone be very small, and too much fluid be in the bladder, the sound may miss it. When the stone is encysted, or lodged in a pouch at the base of the bladder just behind an enlarged prostate, or occupying a dilated ureter, or a pouch in the prostate gland itself, it may be unrecognised.

2. Detection of a stone when the bladder does not contain one.—A hard and fasciculated bladder with calcareous matter adhering to its walls may be mistaken for a calculus; but this gives a rough, grating sensation, and no stone can be isolated. A vesical growth may become covered with phosphates, and be mistaken for a stone. The ring of this is not so loud as a true calculus, and the sensation of roughness greater. The sound may strike adjacent bony parts, especially in children, such as a projecting sacrum or the ischial spines.

Progress and Termination.—The patient becomes thin, worn out, suffers from dyspepsia, dry skin, frequent micturition, atony and atrophy of the bladder, offensive and ammoniacal urine, exhaustion, diarrhœa, and hectic, ending in death.

Changes in Organs.—Prostate enlarged; the bladder may be the seat of cystitis, hypertrophy, ulceration, sloughing, and cysts may form, containing calculi. Acute or chronic inflammation of the kidneys, which may terminate in suppuration.

Treatment.—The stone must be removed by lithotritry or crushing, or by means of a cutting operation to which the term lithotomy is applied.

Lithotritry, or Crushing the Stone.—This operation used to be performed at several sittings, but is now finished at a single sitting (litholapaxy). The old operation is as follows.

Instruments required.—1. *The lithotrite,*

which is a steel instrument cut from the solid block, with a straight shaft eleven inches in length, having at one end a "beak" about one inch in length, and at the other a cylindrical roughened handle. It is composed of two blades, male and female, the former fitting accurately into the latter. The blades are of two forms, open-bladed (with the female blade entirely open, allowing the male blade to pass right through it; this being used to break up large calculi), and flat-bladed (with the female blade broad and shallow, with no opening, or only a small one at its angle). In the latter variety the male blade is smaller than the female, and the edges do not meet; it is used to crush fragments into fine powder. At the end of the handle is a screw moving the male blade, which can be put in or out of gear by means of a button in the cylinder. When out of gear, the male blade slides easily along the female; when in gear, the sliding movement is converted into a screw movement.

2. *India-rubber aspirator*, to remove the fragments of stone after it is crushed. Sir Henry Thompson's, with the trap in the front, is a good form. Clover's is also much used.

3. *Evacuating catheters* of large size (15 to 18), with wide eyes. Three kinds are necessary; one with lateral eyes, one with an eye in the convexity, and one with an eye in the concavity.

Preparation of the Patient.—The condition of the urinary organs must be carefully examined; if irritability of the bladder exist this must be diminished as much as possible. The patient's general health must be attended to, the bowels kept well open, and the digestion regulated. A bougie may be passed every second day to accustom the patient to instruments, and rest in bed for a few days is advisable.

Operation.—The patient, warmly covered, lies on his back in bed, close to the edge, so that his right side is nearest the operator; his hips must be raised upon a firm pillow or cushion, and his shoulders flat on the bed, in order that the stone may be thrown towards the fundus of the bladder, and away from its neck; the thighs and knees are bent up and separated. Ether is administered and the urine drawn off by a catheter, then three or four ounces of warm water are

injected into the bladder, and the catheter withdrawn. The lithotrite, well warmed and oiled, is now introduced in the same manner as a sound, taking care not to depress the handle too soon, and giving a very slight lateral rotatory motion to the instrument as this movement is effected. Sir Henry Thompson writes: "In order to pass the blades easily and safely through the narrow membranous urethra it is necessary to maintain the lithotrite a few seconds at or near the perpendicular, permitting it to progress slowly in that position. This proceeding is accomplished by permitting a part of the weight of the instrument to act as the propelling power, while the penis is drawn up in the same, that is, the vertical direction. In this position the blades slide through the bulbous portion, enter and traverse the membranous portion, and arrive at the prostate. Then, and not before, the operator gradually depresses the instrument towards the patient's thighs." Sir Henry Thompson most clearly describes the method of holding the lithotrite: "First, when the blades have arrived in the cavity of the bladder, the left hand being above the instrument, the cylindrical handle is at first lightly held between the thumb and three fingers, the little finger being free, so that a slight rotatory movement of the instrument can easily be made in its axis when necessary. The wheel-shaped end of the sliding rod, which terminates in the male blade, is then held between the thumb, index and second fingers of the right hand, so that it can be drawn over or pressed in at pleasure. If a stone or fragment be seized, the fingers are to remain on the wheel, with slight pressure to keep the stone between the blades, and the thumb is to be extended to draw upwards the button and change the sliding into a screw movement. If the stone or fragment be small, the fingers are to remain in their place; if it be large, the cylindrical handle is grasped firmly in the palm of the left hand. A turn of the wheel now screws home the male blade, and crushes what has been caught."

The next step of the operation is to seize the stone. This may be achieved in two ways. In the first method (Heurteloup's and Brodie's) the handle is raised gently to depress the beak into

the fundus of the bladder, the male blade withdrawn, and the calculus will often fall between the blades by its own weight. In the second and better method (Thompson), the instrument is passed across nearly to the posterior wall of the bladder before it is opened. It may touch the stone on the way. The beak is then turned towards the side of the bladder opposite to the stone, and the male blade withdrawn; then the blades being sufficiently opened are turned over towards the stone, which is seized. The axis of the lithotrite should be moved as little as possible, and should be kept in the centre of the bladder, sufficiently far in that the male blade can be moved without injuring the neck of the bladder. When the stone is seized, the screw action is brought into play by drawing forward the button on the cylinder. The beak is kept in a vertical position in the centre of the bladder, and rotated from side to side to see that none of the mucous membrane of the bladder is caught between the blades, then the screw is slowly turned and the stone crushed. The button is pushed back, the blades opened, a fragment seized, the button drawn forwards, and the screw again turned, and the other fragments are treated in a similar manner. It is important to keep the lithotrite in the same position as that in which the calculus was first found. When a stone cannot be found by turning the blades on their axis to either side, the lithotrite must be turned half-way round, and the handle raised so as to search the pouch behind the prostate.

Coulson adopts a combination of methods, a slow rotatory motion of the lithotrite on its own axis between the thumb and finger without changing the position of the axis, and at the same time a gentle sliding movement of the male branch backwards and forwards to the extent of half or three-quarters of an inch. In cases where several sittings are used, five to eight minutes is the longest duration of a sitting, at intervals of five days, and the fragments are removed, as far as possible, with an aspirator and evacuating catheter.

Litholapaxy, or Lithotripsy at a Single Sitting was proposed and introduced by Professor Bigelow, and has quite super

seded the old operation spread over several sittings. The steps of the operation are similar as far as regards the seizing and crushing the stone, but all the detritus is removed at one sitting, however large the stone, and however long the operation. At the end of the crushing, or at intervals during it, the lithotrite is withdrawn, a large evacuating catheter (No. 25 to 31) passed, and the fragments removed by a powerful aspirator, which is filled with water, attached to the catheter, and the water injected during expiration. Then, on the aspirator expanding, the water rushes out, conveying the fragments. The catheter should be kept in the centre of the bladder, but when seeking for the last fragments it should be depressed on the floor. If a fragment stop the stream by blocking the eye, press the aspirator once or twice, and the passage will be cleared.

Dangers of Lithotrity.—1. *Bleeding into the Bladder*, which is rare, but if it occur must be treated as before mentioned.

2. *Impaction of a Fragment in the Urethra.*—Occasionally a fragment may become impacted in the urethra, after the operation in several sittings. If lodged low down it must be pushed back into the bladder with a catheter; when nearer the meatus it must be extracted by urethral forceps.

3. *Clogging of the Lithotrite.*—This may occur if a non-fenestrated instrument be used. By opening and closing the blades, and moving the instrument about, the detritus may be washed off; if this be unsuccessful, withdraw the lithotrite, and if this will not pass into the penile portion of the urethra, it must be cut down on in the perineum and the blades cleared with the finger; advantage being taken of the incision to wash out the bladder, and remove the fragments with the finger.

4. *Rupture of the Bladder and Urethra* may occur, if care be not taken, when using the large instruments employed in litholapaxy.

5. *Cystitis and Nephritis.*

After-treatment.—Poultice to pubes, or hot fomentations, and the general treatment of acnte cystitis.

Consequences of the Operation which may Ensur.—1. Urinary fever. 2. Hæmaturia. 3. Cystitis. 4. Nephritis.

5. Uræmia. 6. Pyæmia. 7. Orchitis. 8. Peritonitis. 9. Prostatitis. 10. Atony of the bladder with chronic cystitis and retention is very dangerous, and must be carefully looked for; should there be any residual urine, however slight in quantity, the bladder must be washed out once or twice a day.

Litholapaxy in Children.—This operation has been introduced chiefly by the efforts and brilliant example of Surgeon-Majors Keegan, Freyer, and Goldsmith in India, and Mr. Walsham in England. The advantages are the speedy recovery, and avoidance of incontinence of urine, and risk of emasculating the child. Keegan writes: "I would almost as soon think of performing lateral lithotomy on an old man, the subject of a small uncomplicated stone, as I should think of performing lateral lithotomy on a boy whose urethra readily admitted the passage of suitable lithotrites and evacuating catheters, and whose stone was neither abnormally hard nor large." The operation is performed as in the adult, the chief point being the selection of an appropriately-sized lithotrite, which must be determined when the patient is anaesthetised, and incision of the meatus performed. Boys' urethræ vary much in size; but as a rule, in children over a year a No. 6 English lithotrite and evacuating catheter will pass; over two years a No. 7; over three years a No. 8. By rectal examination the size of the stone and condition of the bladder is determined. The lithotrite must never be forced through the meatus, but this should be incised. An open-bladed lithotrite must always be employed.

Cases suitable and unsuitable for Crushing.—The favourable circumstances are a capacious urethra, soundness of the genito-urinary organs, small size of the calculus (below one inch, but phosphatic calculi of much larger size may be crushed), and a good state of the general health. The unfavourable conditions are, large size of the stone; hardness of the stone; presence of a foreign body, which has served as a nucleus for the calculous formation, and which cannot be crushed; deformity of the urethra, owing to cicatricial contraction. Chronic enlargement of the prostate adds to the difficulties of the operation, but does not prevent its performance. In encysted calculus lithotrity is inadmissible, and in

atony of the bladder is inadvisable. Irritability or extreme sensibility of the bladder, with a hypertrophied fasciculated and contracted condition, predispose to inflammation, and if the stone be of large size crushing should not be performed. In the case of tumours with stone, or disease of the bladder, each example must be decided on its merits. If disease of the kidneys and diabetes be present, lithotripsy cannot be recommended. The tendency to relapse is much greater after lithotripsy than after a cutting operation, from the liability to a fragment being left behind, but at the same time the mortality is much less.

Lithotomy is the removal of a stone through an artificial external opening. There are two situations in which the bladder may be opened to extract a stone: 1. The perineum; 2. Supra-pubic region.

1. *Perineal Lithotomy* embraces several operations; the most usual is the lateral operation.

Lateral Lithotomy.—The operating table must be firm, and of such a height that the perineum is in a line with the operator's face. The surgeon sits on a low stool.

Instruments Required.—1. A staff with a deep groove at the left side. 2. A broad-bladed straight-backed scalpel. 3. Probe-pointed bistoury. 4. Blunt gorget. 5. Forceps, straight and curved, lined with linen to prevent the stone slipping. 6. Scoops. 7. Searcher, which is a slightly curved sound with a bulbous end. 8. A flexible tube petticoated, or the air tampon. 9. Leathern anklets and wrist-bands to tie the patient up, or Clover's crutch. 10. Lint. 11. Catheter, with a syringe to fit, for injecting the bladder. 12. Artery and torsion forceps. 13. Tenaculum. 14. Ligatures. 15. Anæsthetic and inhaler. 16. Oil. 17. Sponges. 18. Bandages and tape. 19. Morphia suppository. 20. Basins of hot and cold water. 21. Ice. 22. Brandy, wine, smelling salts, sal volatile, ether. 23. Hypodermic syringe.

Preparation of the Patient.—The patient's health must be attended to, the stomach and bowels regulated, and the urine rendered as healthy as possible. The patient should be kept quiet in bed for a week or ten days, and have a regular diet. Opiates are often necessary to dull the pain. The day previous to the operation a dose of castor oil must be

given, or a dose of cascara sagrada; and on the morning of the operation the rectum must be emptied by means of a large injection. The perineum must be shaved if necessary.

The Operation.—The patient must be anæsthetised and placed on the table. Four assistants are required besides the administrator of the anæsthetic—one on each side to hold the patient's legs in position; the third to hold the staff, and the fourth to assist the operator by handling the instruments, etc. A full-sized staff is to be introduced, and the stone felt and heard by the operator, and at least one other person; *unless the stone be thus made out immediately before the operation, this must be postponed.*

Position is very important. The patient's breech should project slightly over the end of the table, the head be a little raised on a pillow, and the shoulders low. His hands are then made to grasp his feet, in such a manner that the fingers are applied to the sole, and the thumb to the instep: in this position they are fastened by the leathern anklets and wristbands, or by a bandage; each limb is held by an assistant, having the foot in his hand and the knee under his arm, widely separated and on the same level. The staff must be held by a reliable person in his right hand whilst standing on the patient's left, well hooked up under the symphysis, to keep it steady, with the handle vertical and not depressed; the same assistant with his left hand draws up the scrotum. Cadge recommends as affording facility, especially to the beginner, that the handle of the staff should be considerably inclined towards the abdomen, which will bring the membranous urethra parallel and quite close to the perineum; as soon as the knife point enters the groove the staff is raised and hooked well up under the pubic arch. Some surgeons inject into the bladder a few ounces of water, but this is not necessary, and is rarely retained; the patient should be directed to hold as much urine as possible before the operation.

First Step is to lay bare the groove of the staff by a perineal incision which opens the membranous portion of the urethra behind the bulb and in front of the prostate. The surgeon should trace with his fingers the lines of the rami and examine the state of the rectum with

the finger, the size and condition of the prostate, and make certain that the staff enters at the apex of the prostate and passes through its centre. The external incision is made by entering the knife boldly midway between the anus and the scrotum in the raphe of the perineum or a little to the left of this (Sir William Fergusson, $1\frac{3}{4}$ inches in front of the anus; Erichsen and Sir Henry Thompson, $1\frac{1}{2}$ inches; Brodie, Gross, Stanley, Skey, $1\frac{1}{4}$ inches; Coulson and Keith, 1 inch), and carrying it obliquely downwards and outwards between the rectum and tuber ischii, as far down as the lower margin of the anus, but one-third nearer the ischium than the anus. The length of this incision varies with the depth of the perineum and the supposed size of the stone, but is usually from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches in the adult. Its depth is greatest at the upper angle, it being here usually three-quarters of an inch to one inch. The parts divided will be the skin, superficial fascia, a few fibres of the external sphincter, some fat in the ischio-rectal space, the inferior hæmorrhoidal vessels and nerve. The forefinger of the left hand is inserted into the wound to protect the rectum, and the blade of the knife introduced at the upper angle is drawn downwards to deepen the wound; in doing this the transverse perineal artery and muscle are divided, the lower part of the triangular ligament, the deep transverse urethral muscle and the forepart of the levator ani muscle. If the incision be commenced too far forwards the superficial perineal vessels and nerves may be cut. The knife is withdrawn and the left forefinger pushed deeply into the wound to separate the cellular tissue and feel for the groove of the staff in which the finger-nail is fixed on the inner edge sufficiently far back to avoid the bulb, and to guard the rectum.

*Second Step (Opening the Urethra).—*With the forefinger as a guide the knife is slipped along the nail into the groove, until the two metals be in plain contact. The handle of the knife is somewhat depressed to raise the point, and the blade lateralised, so that it lies parallel with the ischial ramus, is pushed *along the groove* until a feeling of loss of resistance or a gush of urine take place. The knife must be withdrawn without increasing the wound; the length of this deep wound depends on the angle the

knife makes with the staff. The parts divided are the membranous part of the urethra with the muscular fibres about it, part of the prostate and the neck of the bladder. In performing this step of the operation the rectum must be carefully kept out of the way by means of the left index finger, which is retained in the wound.

Third Step.—The forefinger is carried along the staff into the bladder, *dilating* in its progress the neck of the bladder and the prostate, and it will in most cases touch the stone. The stone being felt, the staff is removed. The forceps, closed and warmed, are slipped along the palmar surface of the finger into the bladder, the stone felt for where it lies, which is usually at the fundus. The forceps are opened with one blade flat at the bottom of the bladder, and the other near the top; on closing them with a slight shake the stone is generally grasped. Extraction is then effected, the long axis of the stone being adjusted to the blades with the finger passed along the instrument, by drawing downwards and forwards, with gentle lateral to and fro motion, so as gradually to dilate the prostate. "It is quite impossible to over-estimate the importance of slow and cautious action in this stage of the proceeding" (Thompson). If the perineum be very deep, so that the finger cannot reach the bladder, the staff may be left in to serve as a guide for the forceps, or a blunt gorget may be slipped along the staff into the bladder, and will direct the forceps in the right direction; the staff is then withdrawn, and as soon as the forceps are felt to be in the bladder the gorget is removed. In children, the scoop is the best instrument to extract the stone; the same instrument should be used when the stone is small in an adult, or where the calculus has broken into fragments, and in many cases of encysted calculus it is very serviceable. A searcher must be introduced after the removal of the stone, to ascertain whether another be present.

Parts to be avoided.—In the first incision into the ischio-rectal fossa, the rectum may be cut, if the knife be turned inwards, or if the gut be not guarded by the left forefinger. The pudic vessels on the outer side of the ischio-rectal fossa can be wounded in a child near the anterior part of the hollow, where they

approach the margin of the triangular ligament; posteriorly they lie under the shelter of the ischial ramus. In making the deep incisions, the artery of the bulb will be wounded if the incision be carried too far forwards, and it must necessarily be cut when it arises farther back than usual, and crosses the front of the ischio-rectal fossa. In the final step, the neck of the bladder should not be cut too freely, or the recto-vesical fascia separating the perineum from the pelvis will be injured, and the abdominal cavity opened. Too free an incision through the prostate may wound also an unusual accessory pudic artery, if present.

After-treatment.—The elastic tube is introduced into the bladder, which may be previously washed out with tepid water, and fastened with tapes; a saucer or sponge is placed to receive the urine. The patient is unbound and removed to his bed, guarded with a Mackintosh and draw-sheet. He should lie on his back with his body raised, and the knees bent over a pillow. A full dose of tincture of opium should be given, and warm flannels applied to the abdomen. The diet should be farinaceous for the first three or four days; barley-water is the best drink. The excretion of urine is often scanty for the first day; if it cease, push the tube further in, or pass a catheter through it. With regard to the removal of the tube, in simple, uncomplicated cases this may take place at the end of forty-eight hours, and the patient may lie on his side; but in cases of stone depending on local conditions of the bladder, as chronic cystitis with enlarged prostate, Reginald Harrison has drawn the attention of the profession to the great advantages of prolonged drainage (from four to eight weeks), by the use of his large drainage tubes. He writes: "In determining how long it is necessary to continue the drainage, I attach considerable importance to two points; first, to the condition of the urine; and secondly, to certain muscular actions of the bladder, which becomes more apparent in those cases where atony pre-existed. So long as a patient goes on discharging ammoniacal or very purulent urine, so long must the drainage be continued; as to close the bladder under these circumstances is certain to favour the reproduction of those local causes which contributed to the formation or

growth of the stone. When the urine is becoming normal, one of the earliest indications that the drainage tube may be withdrawn is the voluntary, or, I should rather say, the spasmodic, expulsion of urine along the natural passages." The parts in the neighbourhood of the wound must be well oiled. If the bowels be not moved in six days, a castor-oil enema may be given. The urine generally ceases to flow through the wound by the thirteenth to the fifteenth day. The patient should not be allowed to walk about until the wound be healed, or a fistula may result.

Asston Key's operation.—Key's staff is straight, blunt-pointed like a sound, and more deeply grooved than the common staff, with the groove in the centre running to within half an inch of the end. The knife used is shaped like a scalpel, but longer in the blade, and slightly convex near the point. The first step is similar to that described. Second: The point of the knife is kept steadily against the groove; the operator, with his left hand, takes the handle of the director, and lowers it until he bring the handle a little lower than midway between the vertical and horizontal position, keeping his right hand fixed. Then, with an easy simultaneous movement of both hands, the groove of the director and the edge of the knife are turned obliquely towards the left side of the patient, the section of the prostate is made, the operator looking to the exact line of the director in order to carry the knife safely and slowly along the groove. Having delivered the knife to an assistant, the operator takes the staff in his right hand and passes his left forefinger along the director through the opening in the prostate, withdraws the director, and, exchanging this for the forceps, passes the latter along his finger into the cavity of the bladder.

Lateral Lithotomy in Children is a most successful operation. A No. 8 or 9 staff can be passed as a rule, but great care must be taken that a false passage is not made, as the tissues are very yielding. The staff has been passed below the bladder, the urethra separated from the prostate, and the beak of the staff forced through the roof of the urethra between the bladder and the posterior part of the pubes. In children also prolapsus of the rectum

is very common; it must be returned before the operation. The prostate being very small, the deep incision usually passes quite beyond its limits, but this is not of the same importance as in the adult, for ill results do not follow. If the deep incision be not sufficiently free, it may happen that in attempting to dilate the urethra the latter may be torn across and the bladder pushed up before the finger. Another difficulty, noticed by many good operators, is that of inserting the finger into the membranous urethra; this difficulty may be overcome by a sufficiently free incision in many cases. Cadge recommends the passage of a small pair of dressing forceps instead of the finger; then, the blades being opened, room is made for the finger; he adds, in many cases the stone can be withdrawn with the dressing forceps without using the finger at all. Lastly, the bladder is more an abdominal organ in children, and is placed higher, so that the handle of the knife must be more depressed than in adults in making the deep incision, to avoid cutting between the rectum and the bladder; and, as Gross recommends, the index finger should be kept in close contact with the upper part of the wound, just below the arch of the pubes. The staff should not be withdrawn until the surgeon be well assured that the finger is fully in the bladder, or, what is better, in contact with the stone. Liston wrote: "If possible, and it almost uniformly is so, the stone should be felt with the finger before any instrument is introduced or attempt made to seize it."

Difficulties during Lithotomy.—*The stone may not be found on passing the staff*, although previously felt; this may be owing to its having been passed by the urethra; to its being encysted, or covered by the mucous folds of the bladder; or to the wall of the pelvis having been mistaken for the stone. When this occurs the operation must be postponed.

Failure to reach the bladder is rare in adults, and is either due to the knife leaving the staff and wandering between the rectum and the bladder, or to the prostate being enlarged, and thus increasing the distance of the bladder from the surface, so that the forefinger cannot reach the stone; in the latter

case the staff itself may be used as a guide to the forceps, or a blunt gorget slipped along the staff. In children the knife must be small and very sharp, so that the tissues may be fairly divided. As before recommended, it is advisable not to use the forefinger to dilate the wound, as it is apt to push the bladder and prostate before it, tearing them from the urethra; the groove of the staff being well exposed, a small tapering gorget, or a pair of dressing forceps, should be passed along the staff into the bladder, and serve as a guide for the forceps or scoop.

Difficulties in Extraction.—1. *Owing to peculiarities in the position of the stone.*—It may lie in a pouch behind the prostate; in this case use a pair of well-curved forceps, and tilt the stone up with the finger in the rectum. The stone may rest above the pubes; this is treated by pressing the supra-pubic region, and using a curved scoop, or the index finger. The stone may be encysted, and its extraction impracticable, though an attempt should be made to rupture the cyst with the nail, or a knife shaped like a gum-lancet. The stone may be entangled in the folds of the mucous membrane, or grasped by spasmodic contraction of the bladder walls; in this case a scoop should be used, and if this fail, the bladder well washed out.

2. *From large size of the stone, or deformity of the pelvis*, as the result of rickets or other disease.—All stones two inches and upwards in diameter can hardly be removed by the lateral method. When the stone is so large that it is impossible to bring it through the opening in the prostate without bruising and laceration, the right side of the prostate must be incised by introducing a narrow probe-pointed bistoury into the wound, guided by the forefinger, and directing the edge towards the right tuberosity of the ischium. When it is clear that the stone cannot pass through the pelvis, before the operation, the high or supra-pubic operation should be performed. Crushing the stone through the wound has been recommended, but is not safe.

3. *Breakage of the stone into fragments when seized by the forceps.*—When this occurs from brittleness of the calculus, the pieces must be removed

with small forceps, or a scoop, and the bladder washed out with warm water. If the stone be soft and friable, as in some phosphatic calculi, breaking down into a soft mass, this must be withdrawn by means of a scoop, and the bladder well washed out at the time of operation, and afterwards through a catheter passed through the urethra. The calculus may be conjoined with an incrustated state of the mucous membrane with calcareous matter; the latter, after the stone is extracted, should be removed with the scoop, finger, and by washing out the bladder.

4. *Stones may be left behind in the bladder.*—This is especially apt to happen in old men, with large prostates and a fasciculated bladder. When a stone is removed the surgeon should always bear in mind that *there may be another*, and this is particularly likely to be the case if the stone be broken, or several stones have been discovered: examination with the finger and sound deliberately and carefully performed, washing out the bladder, and then renewing the examination. Should a stone or a piece of one be left behind, the bladder must be washed out, and the position of the calculus being ascertained, it must be removed by long and slender forceps. If the stone be too large the wound may be dilated and then extraction performed, or preferably, after convalescence, litholapaxy may be used.

Risks during the Operation.—1. *Hæmorrhage.* This may occur from the superficial vessels, but these rarely bleed much, and if troublesome must be ligatured after extraction of the stone. If the pudic artery be wounded, which can only occur with the most reckless incision, unless the artery occupy an abnormal position, it can be compressed with the fingers against the ischial tuberosity. Should the bulb be incised it does not bleed to a great extent, but if the artery of the bulb be involved it must, if possible, be ligatured; it can sometimes be seized by a tenaculum, or grasped by pressure forceps, which should be allowed to remain for thirty-six hours. The arteries may sometimes have an abnormal distribution, such that they are necessarily involved in a well-planned operation. Lastly, the hæmorrhage may be venous from the superficial and prostatic plexus; it is best treated by plugging the wound

with the air tampon, or by stuffing pieces of lint in a petticoat, formed of a piece of thin cotton material, round the tube. Another effective resource to be borne in mind is pressure through the rectum by a water bag, or plugging with lint. When the hæmorrhage takes place into the bladder, the latter becomes distended and the patient collapsed; the coagula must be washed out, and all bleeding points stopped with the ligature, plugging, cautery, ice, or hot water; a soft catheter being passed, as often as necessity arises, through the wound. Secondary hæmorrhage may arise in three or four days, from softening of clots; or in one or two weeks when the sloughs are separating; ice to the perineum or pubes, and if this do not succeed, the tube must be reintroduced and firm pressure applied.

2. *Opening the bladder beyond the prostate*, the urethra being missed altogether; this is usually a fatal accident.

3. *Wound of the rectum* is not uncommon. If small it will probably heal up; if large, a recto-vesical fistula may form. When it is not healing, the septum between the external orifice of the wound and the opening of the fistula in the bowel should be divided as in fistula in recto, and be allowed to granulate from the bottom. If the opening be too high up for this procedure, a plastic operation is necessary in chronic cases, where attention to diet, drawing off the water, cleanliness, rest, and stimulating applications have failed to secure cicatrisation.

4. *Wound of the posterior part of the bladder* from within its cavity is rare, and due to the knife being passed too deeply along the groove of the staff, an accident most likely to happen in children.

Various Symptoms after Lithotomy.—Coulson describes: 1. Symptoms of cardiac disturbance, syncope, or angina, occurring suddenly after lithotomy, when the patient is apparently progressing favourably. They are most common in old men. 2. Hiccup may occur in association with peritonitis or pelvic cellulitis, and is then a symptom of grave import; or may be due to intestinal disorder, when it is troublesome but not dangerous, and may last two or three weeks. 3. Fœtid or fœcal odour of the urine, usually the result of an abscess

near the base of the bladder. 4. Secretion of a large amount of non-albuminous urine. 5. Mucous discharge from the rectum, from the pressure of the tampon. Other symptoms which may arise are: 6. Incontinence of urine, particularly in young subjects. 7. Sexual defects, but these are rare, from obliteration or injury to the ejaculatory ducts. 8. Perineal fistula. 9. Phosphatic incrustations of the sides of the wound, which are best removed by injections of nitric or hydrochloric acids (m iv to 3j). 10. Sloughing of the rectum. 11. Orchitis. 12. Phlebitis. 13. Urinary infiltration. 14. Cystitis. 15. Prostatitis, which may be followed by gangrene. 16. Peritonitis. 17. Pelvic cellulitis. 18. Suppression of urine. 19. Tetanus. 20. Pyæmia.

Cause of Death.—1. *Shock* without any distinct lesion; this is most frequent in old people, but occurs in children. 2. *From hæmorrhage and exhaustion.* Death from primary hæmorrhage is rare. Secondary hæmorrhage may prove fatal six to fourteen days after the operation. 3. *From pelvic cellulitis* is most often met with, either due to urinary infiltration of the cellular tissue, in consequence of the deep incision being carried too far back and opening the recto-vesical fascia; or due to laceration and bruising of the neck of the bladder and prostate in extracting the stone, a danger which of course increases with the size. The symptoms are those of severe constitutional irritation, and set in during the first forty-eight hours; rigors; hot, dry skin; rapid, intermittent pulse and dry brown tongue; great prostration and anxiety; the wound appears unhealthy and the pus fœtid. The treatment must be stimulating. 4. *Peritonitis* is rare in adults, but may be secondary to pelvic cellulitis; in children it is the most common cause of death. 5. *Cystitis* is rare. 6. *From phlebitis of the prostatic veins.* 7. *Pyelitis and nephritis* are very fatal, and the operation should rarely be done if the kidneys be much diseased. 8. *Pyæmia.*

Cases suitable for Lithotomy.—Lateral lithotomy is so successful in children that it should be adopted in all cases in which it is not advisable to perform litholapaxy. In adults, where litholapaxy has been attempted but unsuccessfully, lithotomy should be at once performed. In cases

of very hard stone, lithotomy is indicated, and when the urethra is much deformed. In cases of atony of the bladder, or where there is irritability or extreme sensibility of the bladder, with hypertrophy and a contracted, fasciculated condition, lithotomy should be performed. When the stone is large lithotomy is indicated. If the kidneys be much diseased lithotomy should *not* be performed.

Median Lithotomy (Allarton).—The patient being prepared for the operation, and in the same position as for lateral lithotomy, a large curved staff with a central groove is passed and held firmly against the symphysis. The left forefinger is placed in the rectum, to feel the staff at the apex of the prostate and steady it.—(1st Step.) A straight-backed knife, not more than two inches long, with a cutting edge on the back for a short distance from the point, is entered with its edge upwards into the raphe of the perineum, half an inch in front of the anus, and is pushed on towards the bladder so as to enter the groove of the staff at the apex of the prostate, opening the membranous urethra in front of this organ. The knife is pushed almost, but not quite, into the bladder; as it is withdrawn, the wound of the urethra is enlarged upwards towards the bulb, and the skin incision extended towards the scrotum, making it altogether from an inch to one and a half inches in length.—(2nd Step.) A long ball-pointed probe is then passed along the groove of the staff into the bladder, the staff is withdrawn, and the forefinger of the right hand, guided by the probe, dilates the neck of the bladder to the requisite extent.—(3rd Step.) When the stone is felt, the probe is removed, and with the finger as a guide the forceps are introduced and the stone extracted. Eriksen advises a rectangular staff, which is bent to its right angle three inches from the point; this can be felt projecting in the perineum, the upward incision is limited, and the rectum is not so likely to be wounded. Sir Henry Thompson cuts from without inwards, making an incision in the line of the raphe, from about two and a half inches above the anus downwards as near the margin as is safe. The dissection is carried down to the staff, the urethra opened with a long, straight-pointed bistoury in the mem-

branous portion, and the operation completed as described.

Advantages and Disadvantages of the Median Operation.—In the adult both operations are equally difficult, but in the child the median is not so easy to execute as the lateral. There is less bleeding in the median, but the bulb is generally cut. The rectum is more likely to be wounded in the median. It is impossible to open up the pelvic fascia in the median, as the prostate is scarcely incised at all, and there is also no risk of impotence following the operation. Large stones cannot be extracted by this operation, owing to the incision occupying the angle formed by the pubic rami, and to the tight ring which encircles the neck of the bladder behind the prostate not being divided.

Cases suitable for the Median Operation.—1. To extract foreign bodies, as pieces of bougie, etc., from the bladder. 2. In cases of small calculi lodged behind the prostate. 3. In very anæmic patients.

Medio-Lateral, or Buchanan's Operation.—A rectangular staff is used, with a deep lateral groove. This is introduced into the urethra, and by means of the left forefinger in the rectum the angle is made to correspond in situation with the apex of the prostate, so that the gland can be felt just beyond, between the forefinger and the staff; the latter being well depressed, the angle is brought near the surface, where it can be readily felt in the perineum at the anterior border of the anus. The knife is a long straight bistoury, about a quarter of an inch wide, with three inches of cutting edge, and the point sharp at the back as well as at the front.—(1st Step.) The surgeon, with his finger in the rectum, enters the knife opposite the angle of the staff, immediately in front of the anus; the blade being horizontal, and the edge directed to the left, is pushed straight into and along the groove as far as to the stop at its extremity. The bladder is thus entered at once with the blade parallel to the horizontal branch of the staff, and a few drops of urine will escape.—(2nd Step.) The bistoury is withdrawn slowly, cutting outwards and downwards a distance more than equal to another breadth of the blade, and then directly downwards to the same extent, describing a quarter of a circle above and to the left side of the rectum, and forming

a wound about $1\frac{1}{4}$ inches in length. If the stone be large a similar incision is made on the right side. The operation is completed in the usual manner. The advantages claimed are: 1. It is more easily and rapidly performed than the lateral. 2. The parts are less divided. 3. There is not so much bleeding, or risk of wounding the rectum, or of urinary infiltration.

Bilateral Lithotomy (Dupuytren).—The patient is placed in the usual position and a central staff introduced. The operator draws the skin of the perineum tense with his left hand, and makes a semilunar incision transversely across the perineum, beginning midway between the anus and right tuber ischii, passing half an inch above the anus, and terminating midway between the anus and the left tuber ischii. The dissection is carried down through the skin, superficial fascia, and a few of the anterior fibres of the external sphincter, whilst the bulb is drawn forwards if met with. The left forefinger is then inserted into the wound, the groove of the staff felt, and the membranous part of the urethra divided on the staff and in the middle line for a distance of half an inch from behind forwards. The double lithotome caché is composed of a flattened, slightly curved, metallic sheath, which is blunt-pointed and mounted on a handle; within this sheath are two blades, sharp on their concave borders, which project on pressing a lever in the handle, the degree of projection being regulated by a screw. The nail of the forefinger being applied to the staff, the lithotome caché is introduced closed, with its concavity upwards, and pushed along the groove into the bladder; the staff being withdrawn, and the lithotome felt to be fairly in the vesical cavity, the instrument is turned downwards, the blades protruded by pressing the lever, and in this manner, during its withdrawal downwards and outwards, it incises both lobes of the prostate. The operation is finished in the usual manner. This method is easy, allows the passage of large stones, and can be used when there is malposition of the thighs, but its results are not so favourable as lateral lithotomy, and there is the danger of both seminal ducts being divided.

Nélaton's Pre-rectal Operation is a modification of bilateral lithotomy, the objects proposed being: 1. Avoidance of injury to the bulb; 2. To make the

opening into the urethra with certainty at a fixed point.

The Operation.—(1st Step.) The staff being passed into the bladder, the operator's left forefinger is introduced into the rectum, to ascertain the apex of the prostate and its relation with the anus. A curved incision is made with its centre half an inch in front of the anus, and falling slightly on either side, in all about one and a half inches or more in length.—(2nd Step.) A short incision in the line of the raphe should fall perpendicularly into the centre of the first incision.—(3rd Step.) The dissection is slowly carried along the sphincter of the anus, so as to detach downwards the anterior fold of the rectum, and separate it from the bulb above, directed by the left forefinger in the bowel.—(4th Step.) Arrived at the membranous part of the urethra, a straight-pointed bistoury is passed into the urethra, just at its junction with the prostate, entering the groove of the staff.—(5th Step.) Into this opening the double lithotome caché is placed, and the incision of the prostate made as in Dupuytren's operation. There is some risk of a fistula remaining.

High or Supra-pubic Operation.—Previous to the operation, Schmitz, of St. Petersburg, prescribes a strict milk diet for two or three days, and if cystitis be present, gives benzoic acid. On the day before the operation he directs the patient to have a dose of castor oil, and the next morning an enema, followed by a few drops of tr. opii. The patient lies on his back, with the head and shoulders slightly raised, and his legs hanging down over the edge of the table. The pubic region is shaved, and ether administered. A silver or elastic catheter is passed into the bladder and the urine drawn off. An india-rubber bag of flattened shape, with a canvas lining, is passed into the rectum, having been previously smeared with eucalyptus and vaseline, and when it is placed above the sphincter it is distended with from ten to twelve ounces of water, if the patient be an adult, and with from $2\frac{1}{2}$ to 5 ounces in a child of five years of age. By means of the catheter, from eight to ten ounces of Thompson's fluid (borax 1 part, glycerine 2 parts, water 2 parts), diluted 1 in 6, is injected into the bladder. The catheter is withdrawn, and the urethra compressed by tying a Jaques' catheter (or in a child a

small drainage tube) round the penis. The object of these manœuvres is to raise the bladder well out of the pelvis, and ensure that the peritoneum shall be out of harm's way.

First Step.—This consists in laying bare the wall of the bladder, the patient being well under an anæsthetic, and the hypogastric region supported by the hand. Standing on the patient's left side, the surgeon transfixes the skin and subcutaneous fascia, the lower end of the incision overlapping the pubes. The wound, which is about three inches in length, exposes the linea alba, when the subcutaneous fat is cut through. The linea alba and the fascia transversalis are cautiously incised near the pubes, and divided upwards as far as may be necessary on a Key's director as a guide. The pyramidal muscles are divided close to the pubes. The peritoneum, if seen, is pushed well upwards with the finger. Sir Henry Thompson writes: "The yellow fat characteristic at this point of proximity to the bladder, and looking to the inexperienced eye uncomfortably like a mesenteric protrusion, comes into view. It is explored with the separator, while the veins traversing the region are carefully drawn aside, until the fibres of the bladder may be identified and a fluid impulse be detected by the finger." All hæmorrhage from the veins, which are often large and engorged, with friable walls, must be arrested by pressure forceps. Rough manipulation of the cellular tissue between the bladder and the symphysis must be avoided, or supuration may occur, or urinary infiltration; if such should happen, this is a difficult part to drain properly.

Second Step.—Opening the Bladder.—The latter is recognised by its pink surface, fluctuation, and by the fibres of the detrusor urinæ. It is transfixed with a ligature, passed by a curved needle, on each side of the proposed opening, or a small hook may be used. The bladder is then opened by a brisk plunge of the scalpel, held at a right angle with the edge downwards, in the space between the ligatures, and the finger inserted as the urine flows.

Third Step.—A pair of straight forceps is introduced, and the stone extracted; or a finger and the scoop, or both index fingers, may be used in lieu of the forceps.

Fourth Step.—Concerning the subsequent procedure opinions at present vary much. Is the wound in the bladder to be left open, or carefully sutured? Sir Henry Thompson prefers to leave the bladder wound and the external wound freely open, a good sized rubber or silk elastic drainage tube, with one lateral opening at the inner end, being inserted into the bladder and fastened to the external wound, and the patient told to lie on his side or abdomen. But in young persons, and where the urine is in a healthy condition, the bladder wound should be stitched after Lembert's method (*vide* Wounds of Intestine) with catgut or fine carbolised silk. The skin wound is carefully stitched with deep wire sutures, and supported by broad plaster and bandage, aseptic dressing being used. Again, there is great difference of opinion as to whether a catheter should be tied in, if the bladder be sutured, or passed frequently; the latter method seems preferable. In cases of tumour, etc., when the bladder has been opened, the electric light may be used to thoroughly inspect it, or the Trendelenburg position as recommended by Dr. Keyes. The latter consists in having the knees of the patient crooked over the shoulders of a sturdy and tall assistant, while the pelvis is propped up upon a thick wedge-shaped cushion and pillows, so that the shoulders may be very low and the pelvis very high. If now the wound be turned towards a window, by the aid of loops and retractors the entire inside of the bladder may be clearly seen. If the urine be very fœtid, and the bladder fasciculated and contracted, it is advisable to make a counter opening through the perineum, and drain through this.

Dangers.—Injury to the rectum from over-distension; rupture of the bladder, from the same cause; urinary infiltration; cellulitis; and venous hæmorrhage, both primary and secondary.

Cases suitable for this operation.—This method of cystotomy has been so much improved that it will in time probably rival lateral lithotomy, and even now is to be recommended in cases of disease of the prostate, urethra, and in very young children. Surgeons who have not much experience will find this the easiest operation. It is to be recommended in certain cases where foreign bodies have made

their way into the bladder and become impacted. In some instances it is indispensable, as in cases of very large calculus, encysted calculus, deformity of the pelvis, when the perineum is so diseased that no operation can be performed through it, when a staff cannot be introduced, in ankylosis of both hips, and in tumours of the bladder.

Instruments required.—1. Petersen's elastic bag for distending the rectum (Steele's modification of Barnes' bags will serve). 2. Catheters. 3. Drainage tube. 4. Scalpel. 5. Fine sharp hook. 6. Thompson's separator. 7. Key's director. 8. Artery and torsion forceps. 9. Compression forceps. 10. Catgut and silk sutures, with fine needles. 11. Thompson's fluid. 12. Retractors. 13. Lithotomy forceps. 14. Ligatures. 15. Silver wire. 16. Electric light with battery. 17. Ether and inhaler. 18. Aseptic dressing.

Urethral Calculus.—A calculus may be impacted in the urethra, especially in children.

Causes.—The stone may be of renal origin (uric acid or oxalate of lime), and pass into the bladder, and thence into the urethra, where it may become fixed generally in the membranous portion. In rare instances the stone is formed primarily in the urethra, in which case it is, as a rule, phosphatic. This formation is due to the urine collecting behind a stricture, leading to the formation of a pouch wherein particles of gravel collect and form a stone.

Symptoms.—These vary. There may be acute pain at the seat of the stone. Micturition may be free, frequent, difficult, or there may be retention, in accordance with the size and shape of the stone. Bleeding may occur if the stone be irregular or angular. The stone can be detected by a small sound with the finger outside the urethra and behind the stone to prevent it slipping back; occasionally the stone can be felt through the walls of the urethra. Rectal examination is sometimes of service.

Results.—If not removed, dilatation of the urethra, ulceration, rupture, extravasation of urine, abscess, urinary fistula.

Treatment.—If situated anterior to the scrotum it can be removed by the urethral forceps. When opposite the scrotum it must be pushed back to the membranous portion, and then cut down on and extracted with forceps by the

median operation, performed on a staff passed down to the stone, which must be prevented from slipping back into the bladder by the operator's finger. In the adult it is better to press it back into the bladder by means of a hollow-ended catheter, and perform litholapaxy.

Prostatic Calculi are formed in the ducts of the prostate gland. They consist of phosphate of lime, a little carbonate of lime, and animal matter. They generally occur in old people.

Characters.—In number they vary from one to a hundred or more; in size from a grain of sand to a cherry stone, and even as large as a chestnut. Their form is triangular. The colour is brown chestnut, whitish, black, or red. They are compact, firm, and brittle. They are frequently associated with other diseases of the urinary organs, as stone in the bladder, urethral stricture, and prostatic hypertrophy.

Symptoms.—Those of enlarged prostate with prostatitis. The stones can be felt through the rectum, and are often apparent to the sound.

Treatment.—If troublesome they can be removed by a median operation, with the aid of the scoop or forceps.

Calculus in the Female is rare.

Symptoms are the same as in the male, and, in addition, bearing down pains and incontinence of urine.

Diagnosis.—The sound, and examination per vaginam, will detect the stone.

Treatment.—1. *Urethral dilatation or lithectasy* may be performed, either slowly by the passage of bougies, sponge tents, etc., gradually increasing in size; or rapidly under an anæsthetic, with a three-bladed dilator. The forceps are then introduced and the stone extracted.

This is the best method for small stones. If necessary, dilatation may be conjoined with partial division of the urethra with a probe-pointed bistoury in a downward and outward direction, in cases where dilatation has been carried to its proper limits, and there is not sufficient space. The danger of this method is permanent incontinence of urine.

2. *Litholapaxy* is applicable to all stones up to a walnut in size. The handles of the lithotrite should be shorter than in the male.

3. *Lithotomy.* Suprapubic as in the male, with distension of the vagina instead of the rectum; this method, however, can but rarely be required.

Urethral Lithotomy.—The patient is placed in the lithotomy position, and a grooved staff introduced. A sharp-pointed bistoury guided by this is pushed through the floor of the urethra directly downwards, and $1\frac{1}{2}$ inches from the meatus. The forceps are introduced and the stone extracted. The urethra must be stitched by silver sutures and a catheter retained. The risk is a fistula may follow.

Vaginal Lithotomy.—The posterior wall of the vagina is held back by a Sims' speculum. A straight-grooved staff is passed and held in the middle line, the end being pressed down against the anterior wall of the vagina. Guided by the groove, the surgeon makes an antero-posterior incision in the middle line of the anterior wall, about one inch in length, commencing just behind the urethra. The forceps are passed in and the stone extracted. The wound must be stitched together with silver sutures, or a fistula may remain.

CHAPTER XXXVIII.

DISEASES OF THE KIDNEY AND CHOLECYSTOTOMY.

Perinephric Abscess occurs from acute or chronic inflammation of the cellular tissue surrounding the kidney.

Causes.—Traumatic injury; chill; following one of the continued fevers; as the result of inflammation spreading from adjacent parts, as the pelvis, colon,

testicle and cord, vertebræ, spleen, liver, and gall bladder; most usually as a sequence of suppurative pyelitis, or nephritis. It is most common in adult life and in women.

Symptoms.—1. Lameness, due to the flexed position of the high, from in-

inflammation of the psoas muscles; in some cases there is inability to extend the thigh. 2. In sitting the patient rests only on one tuber ischii. 3. Swelling in the region of the kidney, at first hard and painful, finally deep-seated fluctuation can be detected by one hand placed behind the loin and the other pressed down in front. 4. Deep-seated and intermittent pain. 5. Fever. 6. If the abscess follow injury, pus may be present in the urine. 7. Œdema of one foot and leg is sometimes an early symptom. 8. Pneumonia on the same side is a common complication, and may mask the abscess. 9. Emphysematous condition of the cellular tissue of the back. The symptoms are badly marked in chronic cases and in the old and feeble. The prognosis is always threatening. The abscess frequently bursts into the lung or pleura, occasionally into the colon, peritoneum, or externally.

Treatment.—Dry or wet cupping, counter-irritation, purging, hot hip baths. When pus is suspected use the aspirator or make an exploratory incision. If matter be discovered, an opening should be made, as in colotomy, and the abscess cavity washed out with solution of iodine or carbolic acid, and a drainage tube inserted. Lister's dressing is useful. Absolute rest in bed. The operator should always examine the kidney with the finger, and be guided by the result. Good food, tonics, and stimulants.

The diseases of the kidney which can be successfully treated surgically are those which only affect one kidney, and are thus given by Clement Lucas: floating kidney, hydronephrosis, cyst, hydatid, pyonephrosis, sarcoma, and calculus.

Floating Kidney.—The kidney may be unusually mobile under the peritoneum (movable kidney), or the kidney may be entirely covered with peritoneum, thus being suspended by a meso-nephron (floating kidney). This condition is most commonly met with in females, and on the right side, owing to the fact that the right kidney has a longer renal artery, and is more likely to be displaced by the pressure of tight lacing, which acts by depressing the liver and through this the kidney. Other causes which may occasion this disease are repeated pregnancies, undue enlargement of neighbouring organs,

pressure of tumours, mechanical violence, violent muscular exertion, disappearance of fat round the kidney, or looseness of the connective tissue, etc. The kidney may not only be out of its place, but often assumes a horizontal or oblique direction.

Symptoms.—On examining the abdomen a distinct tumour is felt on palpation, and the normal site of the kidney yields a clear note on percussion. The tumour is freely movable, especially upwards or to either side, and does not increase in size. There may be flattening of the loin. The tumour may slip in to its place when the patient lies on her back, and return on her changing her position. Pain may be slight or very severe, resembling that of renal colic; sickening pain on pressure. Sense of dragging and weight in the loin. The urine is healthy, but micturition may be frequent. Care must be taken not to mistake a faecal accumulation for a floating kidney.

Treatment.—Reduce the kidney to its place by the hand; to assist this manœuvre the patient should lie on her back with her limbs drawn up and body bent forward. Rest, pad and belt. The patient must not wear corsets, and the bowels must be kept regular. If there be much pain or inconvenience, nephro-raphy must be performed, which consists in cutting down on the kidney through the loin under aseptic precautions, replacing the kidney, and afterwards stitching it with catgut sutures passing through the capsule and the margins of the wound. The position of the kidney at the back of the abdomen, lying on the quadratus lumborum and psoas muscles opposite the two lower dorsal and two upper lumbar vertebræ, is to be remembered. The left kidney is lower than the right, both at its superior and inferior borders. If violent suffering still continue, the kidney may be removed by nephrectomy through the loin, though this is not a procedure that can be recommended.

Hydronephrosis, or Dropsy of the Kidney, results from any more or less permanent closure of the ureter.

Causes.—It may be congenital, and is then due to impermeable ureter, obliquity or twist of the ureter, valvular conditions of the mucous membrane,

and imperforate urethra. It may arise subsequently from the impaction of a calculus or other body; stricture of the ureter from ulceration; pressure by a tumour or retroflexed womb. This condition is twice as common in women as in men, and usually only affects one organ, but both kidneys may be involved.

Results.—Dilatation of the pelvis of the kidney by urine. Flattening of the papillæ, with compression and atrophy of the pyramids and cortex; the calyces are stretched and converted into huge spaces, and there is distension of the capsule; the ureter above the stricture will be greatly enlarged, distended, and convoluted. Finally, the capsule forms a sac containing fluid, which may occupy separate chambers of large size.

The fluid contents are urine more watery than usual, and containing albumen, but only a slight amount of urea. The disease may prove fatal, by pressure on the abdominal organs, or by bursting into the peritoneal cavity. In the diagnosis of this and other affections of the kidney it is important to see if the supposed healthy organ be doing its work. Combined examination with a hollow sound in the bladder, and the forefinger or the hand in the rectum compressing the ureter against the pelvic wall on the diseased side, will show if the other kidney be working, as in this case urine can still be passed into the bladder and drawn off. Davy's rectal lever is a useful means of compressing the ureter, or the ureter may be catheterised with the aid of the electric light.

Symptoms.—A painless, soft, more or less fluctuating renal tumour, in the flanks and lumbar region, extending forwards in an antero-lateral direction; the tumour may feel lobulated. The urine is normal. If the obstruction be removed, the tumour disappears, accompanied with an increased flow of urine. In some cases in which no tumour exists there are thirst, frequent micturition, partial, total, or intermittent anuria, pain in the back, and more or less abdominal pain. In all doubtful cases it is advisable to use the aspirator for diagnostic purposes. Occasionally the tumour may attain large dimensions, even filling the whole abdomen, and resembling an ovarian cyst, from which it is distinguished by the

history; by its enlarging forwards from the loin, the uterine being mobile and not displaced, and the bowels, especially the colon, being in front of the tumour and presenting a clear note on percussion. The subcutaneous veins are oftentimes much enlarged and distended. In extreme cases the patient soon dies in a state of stupor or convulsions, from uræmic poisoning.

Treatment.—Palliative consists in aspirating the tumour through the loin; for the left side, the needle should be introduced just anterior to the last intercostal space; for the right kidney, between the last rib and the iliac crest, two inches behind the anterior iliac spine. Tapping may be repeated several times.

Curative. An incision is made through the loin, the cyst drained through a large rubber tube fixed to it, and the margins of the cyst wall stitched to the wound. The cyst is washed out with an antiseptic daily, and it will then frequently shrivel up. If this measure be not successful the kidney may be removed by nephrectomy through the loin.

Cysts of the Kidney.—The only form of cyst which is of surgical interest is the scattered cysts arising in the cortex of an otherwise healthy kidney, and attaining frequently a large size, and producing a fluctuating tumour. These cysts are due to dilatation of the Malpighian capsules, or distension of the uriniferous tubules; they do not, as a rule, open into the pelvis, and contain a limpid yellowish or reddish serum, or a gelatinous substance containing a little albumen and some saline matter; rarely, if ever, is any urinary ingredient met with.

Symptoms.—They commence insidiously, grow slowly, show themselves first in the loins, or lumbar region of the front of the belly, and are often so hard at first as to be mistaken for solid growths. Hæmorrhage may occur in them, or cancer be developed in their wall. As they increase in size the kidney is flattened and spread out over the attached part of the cyst wall. When of large size they nearly fill the abdomen, and may be mistaken for ovarian cysts; hydronephrosis; perinephric fluid collection; solid tumours of the parietes; malignant cystic tumours; hepatic or

splenic cysts, or cysts of the omentum, mesentery, or pancreas; hydatids. Morris gives as a point of service in diagnosis: "Right renal swellings have the ascending colon in front and to the inner side of them, and that left renal swellings have the descending colon crossing their front surface."

Treatment.—Aspirate. The best place to aspirate the right kidney is half way between the crest of the ilium and the last rib, from 2 to $2\frac{1}{2}$ inches behind the anterior superior spine of the ilium; for the left, the interval between the two last ribs, near their anterior extremities, the aspirating needle or trocar is directed somewhat forwards. If the cysts refill, drain through the loins if possible; if not, through the front or side of the abdomen. The edge of the cyst is to be stitched to the edge of the parietal wound.

Hydatid Tumours of the Kidney occasionally occur in one kidney, usually the left. The tumour commonly bursts into the renal passages and discharges its contents with the urine. The hydatids may be developed in the parenchyma of the organ, or in the excretory passage. They vary in size from minute cysts to those the size of an orange, and are most common from thirty to forty years of age.

Symptoms.—A globular tumour, often irregular and lobulated, tense, fluctuating; occasionally presenting the hydatid fremitus when the tumour is made tense with one hand and percussed with the other. As a rule, there are no renal symptoms. If the cyst burst renal colic may arise from the vesicles passing along the ureter, and these may be evacuated with the urine, in which case the characteristic hooklets may be detected by the microscope.

Terminations.—1. Spontaneous recovery, the hydatids dying and passing off with the urine. 2. Passage through the lumbar region into the intestines or lungs. 3. Death. 4. Recovery after appropriate treatment. •

Characteristics of fluid when removed by the aspirator. The fluid is watery, saline, faintly milky, and echinococci or hooklets can be seen under the microscope: *there is no albumen.*

Treatment.—Aspiration of the cyst through a fine canula, or siphon tapping. If this be unsuccessful, ne-

phrotomy. Oil of turpentine is useful in diuretic doses.

Nephrotomy, or simple incision into some part of the kidney, is performed for hydronephrosis when the cysts refill quickly after puncture; for hydatid cysts, which cannot be completely emptied by aspiration; for pyonephrosis; for calculous or tuberculous pyelitis, etc.

Instruments required.—1. Scalpel. 2. Dissecting forceps. 3. Artery and torsion forceps. 4. Retractors. 5. Thick sand bag. 6. Compression forceps. 7. Probe and director. 8. Sponges. 9. Absorbent cotton. 10. Silver and silk sutures. 11. Aseptic dressing. 12. Drainage tube. 13. Anæsthetic and inhaler.

Operation.—The patient is placed on the opposite side, with the sand-bag under the flank, to render the side which is the seat of the operation prominent. The steps are similar to those for lumbar colotomy.—(1st Step.) An incision is made at the situation for lumbar colotomy, beginning over the outer edge of the erector spinæ muscle, and continued forwards for $3\frac{1}{2}$ inches. Some surgeons prefer an oblique or longitudinal incision. Divide the skin, superficial fat, and fascia, exposing the outer border of the latissimus dorsi, and posterior border of the external oblique.—(2nd Step.) Divide the two muscles mentioned on a director for the full extent of the wound.—(3rd Step.) Divide the internal oblique and fascia transversalis, exposing the outer border of the quadratus lumborum.—(4th Step.) Divide the deep layer of the lumbar aponeurosis.—(5th Step.) The perirenal fat is now recognised, all the soft parts being well retracted, and is torn through with the finger or probe; all bleeding points are secured with compression forceps.—(6th Step.) The cavity or cyst is tapped, or at once cut into, irrigation with an antiseptic solution well applied, the cyst wall stitched to the margin of the wound, a drainage tube inserted provided with a shield, sutures of silver or silk introduced to close the anterior part of the wound, and the rest left to granulate.

Pyonephrosis, or accumulation of pus in the pelvis of the kidney, arises from suppurative pyelitis, produced by obstruction of the ureter; renal calculus; tubercular or cancerous deposits; disease of urethra, prostate, or bladder; in cases

of hydronephrosis which have been punctured, or sustained some mechanical injury; occasionally as the result of penetrating or contused wounds of the kidney.

Symptoms.—The objective symptoms are similar to those of hydronephrosis, but the tumour never passes the middle line. The urine is increased in quantity, generally acid (unless there be cystitis), and contains pus in large quantity. If the ureter be obstructed, the pus disappears from the urine, while the tumour increases; should the obstruction be removed, much pus is again discharged. Aspiration will disclose pus.

Subjective. — Deep-seated pain and tenderness in the loins, increased by pressure or movement. There is fever, especially in the evening, and often rigors, particularly if there be renal colic.

The pus may burst through the distended pelvis, and point in the loin, groin, or elsewhere; or may pass through the diaphragm into the lung, or penetrate the colon.

Treatment.—If possible, remove the cause of the obstruction; if this be impossible, or there be constant pain, the tumour increasing in size; irritation, inflammation, or adhesion to the surrounding organs; or if the tumour threaten to ulcerate or rupture—perform nephrotomy, and drain the tumour through the loin. Should this measure not succeed in closing the sac, and there be much discharge, perform nephrectomy through the loin, and as the kidney is usually adherent, open the capsule, and turn the kidney out, leaving the capsule behind. Unless this procedure be adopted, there is danger of the other kidney becoming reflexly affected.

Sarcoma, of the medullary kind, is frequent in children under five, and also occurs late in life.

Symptoms.—It is met with as a swelling in the region of the kidney, which very rapidly reaches a large bulk, growing forward into the abdomen, and pushing the colon in front of it. This latter fact separates it from the liver or spleen. The tumour is solid, firm or elastic, and may be smooth and regular, or somewhat knotty and irregular. It can often be felt in the lumbar region. Hæmaturia may be present.

Treatment.—Nephrectomy by a ven-

tral incision is usually necessary, as the tumour is large.

Renal Calculus, or Nephro-lithiasis.

Symptoms.—Pain in the loin, extending to the groin, thighs, and testis, or end of the penis; sometimes heavy and continued pain over the sacrum; retraction of the testicle; painful and frequent micturition; bloody urine; tenderness on palpation over the kidney; and nausea. The symptoms are increased by violent exercise or jolting. The urine may contain pus or unorganised sediments as uric acid and oxalates. It is to be noticed that any or all of these symptoms may be absent. If the stone pass along the ureter, renal colic is occasioned; there will be agonising pain in the loin, extending down the cord, testicle, penis, and inner side of the thigh; retraction of the testicle; nausea and vomiting; restlessness; constant desire to pass urine, which is scanty or suppressed, high coloured, and bloody. In some cases the sound kidney secretes an unusual amount of urine. Collapse and faintness may supervene, and even convulsions. There is little or no fever. The duration varies from a few minutes to days. The pain is remittent, and ceases when the calculus reaches the bladder, which generally takes from twelve to twenty-four hours.

Treatment.—For renal colic,—hot hip baths, mustard poultices to the loins, or hot opium and belladonna fomentations. Large doses of opium by the mouth or rectum, or morphia hypodermically. Barley-water or potash-water to drink. In bad cases, chloroform or ether inhalation. Reginald Harrison writes: "There is a plan of favouring the expulsion of small calculi, after their descent into the bladder, which is by no means a bad one. It consists in making the victim lie on his belly, so as to bring the calculus on to the anterior wall of the bladder, then causing him to rise on 'all fours,' and thus to micturate." If this do not succeed, the stone should be crushed in the bladder, as soon as possible, with a lithotrite. Nephro-lithotomy should be performed when the symptoms are severe, and not eased by a fair trial of rest and medical treatment; when anuria is present, following symptoms of renal calculus, the kidney last affected should be first explored. Morris writes: "If for several months a person

have been subject to more or less pain in one loin, and along the ureter, and perhaps also in the testicle of the same side, if there have been recurring attacks of colic, and especially if, with these symptoms, there have been occasional hæmaturia, or the urine have constantly been charged with a *little* pus or albumen, we have the conditions not only justifying, but demanding an exploration." If the calculus be retained in the kidney, pyelitis, pyonephrosis, or renal abscess may occur.

Nephro-lithotomy is very similar to nephrotomy. An incision is made in the lumbar region $4\frac{1}{2}$ inches in length, parallel to and three-quarters of an inch below the last rib, and dividing the same structures as in nephrotomy. All bleeding vessels being secured, the assistant, with retractors, draws back the edges of the wound, and the surgeon tears through the perirenal fat with two pairs of dissecting forceps. The kidney is then felt with the finger to ascertain the presence of a stone; if no stone be found, puncture the kidney in a systematic manner with a long needle; if still unsuccessful, the surgeon passes his hand in front of the kidney, by the outer edge, and the pelvis of the kidney is pushed against the psoas muscle, when the calculus may be detected. If still the case be doubtful the pelvis should be incised and explored with the sound or finger. When a stone is perceived in the substance of the kidney, this is cut into with a probe-pointed straight bistoury, or Paquelin's cautery knife, sufficiently to admit the finger, and the opening dilated with the finger or dressing forceps; the cut should be made in either of the planes of the uriniferous tubules. The calculus is then removed with the probe or finger. Hæmorrhage is usually brisk, but can be stopped by pressure with a sponge, and compression of the abdomen. The kidney is drained through a drainage tube in the back of the wound, which is closed elsewhere by sutures; the urine passes by the loin for three or four weeks, and a large pad of moss peat is placed so as to receive the urine.

Dangers.—1. Hæmorrhage. 2. Cellulitis. 3. Renal abscess. 4. Renal fistula.

Prognosis is very favourable.

If the kidney be much disorganised, and the stone large and embedded, nephrectomy is advisable.

Nephrectomy, or excision of the kidney.

Cases suitable.—When the organ is disorganised from calculus or other causes; tumours; certain cases of ruptured or wounded kidney.

(a) *Through the loin*.—This operation is extraperitoneal, and is performed either by making a vertical incision at the outer border of the quadratus lumborum muscle, between the last rib and the crest of the ilium; or by making an oblique incision higher than that for colotomy, about half an inch from the last rib and parallel with it, and a vertical incision along the anterior border of the quadratus lumborum, commencing a quarter of an inch below the upper border of the last rib, and reaching to the iliac crest. The eleventh and twelfth ribs must be well drawn up out of the way, by means of a strong retractor. The steps of the operation are the same as those of nephrotomy, until the fat round the kidney and the kidney be reached. A double ligature of carbolised silk, threaded in an aneurism needle mounted on a long handle, must be passed between the renal vessels and the ureter, the ligature is divided, half being applied to the renal vessels and the other half to the ureter; the ligatures are pressed well inwards towards the front of the spine, whilst the kidney, if possible, is drawn well up in the wound by the right hand, the *lower ribs being raised forcibly upwards with the fingers of the left hand*. Another ligature is then passed round the whole pedicle and tied tightly. The ligatures should be cut short and the pedicle divided. The kidney is then removed by the finger, including the capsule, but if the latter be adherent it is best to enucleate the kidney, following closely its surface, and leaving the capsule *in situ*. The pedicle is dropped into the wound and a drainage tube inserted. The wound is then closed, and an aseptic dressing applied.

Morris writes: "The dangers of the lumbar operation are that, (1) the peritoneum or colon may be torn open; (2) too great strain on the vessels of the pedicle may cause their laceration, or the ligature may slip after the kidney has been cut off; (3) the kidney may be broken in the manipulations required for its separation and withdrawal. Laceration of the kidney requires the control of hæmorrhage by pressure, and by hastening the completion of the removal;

a great safeguard against hæmorrhage from laceration is the application of the double ligature before attempting to withdraw the kidney. If the ligature have slipped or fail to control the vessels of the pedicle, or if troublesome hæmorrhage from any source arise, it can best be managed by the application of one of Well's large ovariotomy forceps, which should be left in the wound, and will, in addition, act very well instead of a drainage tube. If the colon be torn, the rent should be closed by suture; if the peritoneum, it may be either sutured or left without stitches."

(β) *By Abdominal Incision, or Trans-peritoneal Operation.*—An incision may be made in the middle line extending three inches above and three inches below the umbilicus; or the abdomen may be opened at the outer border of the rectus (Langenbuch's incision). The intestines are kept away from the surface of the kidney by means of a large flat sponge introduced into the abdomen. In the median method a transverse incision is made in the anterior layer of the meso-colon, care being taken of the large veins which run transversely, and which should if necessary be secured by double ligatures, and divided; in Langenbuch's incision the outer layer of the meso-colon is opened sufficiently in a vertical direction to allow the entrance of two or three fingers behind the peritoneum, and into the perirenal fat; the fingers should scrape their way to the renal vessels, which are tied. At this stage the meso-colon may be stitched by catgut to the edge of the anterior peritoneal wound, shutting off the peritoneal cavity. The ureter is seized by two pairs of ovariotomy forceps, and divided between them. The kidney is enucleated and the pedicle divided external to the ligatures. The ureter may be tied with silk or brought out through a counter opening in the loin, and fixed by sutures.

(γ) *Lateral Retro-peritoneal Nephrectomy.*—Thornton makes an incision parallel with the linea semilunaris, but farther out, and reaches the kidney by raising the colon and peritoneum. The curved incision for ligature of the common iliac or aorta can also be used.

Cholecystotomy consists in opening the gall bladder for the removal of gall stones. This may be performed in two ways. 1. The gall bladder may be stitched to the

parietes, and after an interval, to allow of adhesions forming, an opening may be made (Maunder). 2. The gall bladder is opened and stitched to the parietes at the same time (Marion Sims and Lawson Tait). An incision three to four inches long is made either in the linea alba, over the outer border of the rectus, or over the prominence of the tumour, parallel with the linea alba. All bleeding points are secured, and the peritoneum opened, sponges being placed round the incision. When the gall bladder is exposed it is emptied by aspiration, seized by pressure forceps, and drawn well forwards through the abdominal wound, and afterwards incised at the point of puncture sufficiently to admit the finger freely. The cut edges are to be held well up into the external wound, so that none of the contents may escape into the peritoneal cavity. With small pieces of sponge fixed in holders the cavity of the gall bladder is well cleansed, and any calculus removed with suitable forceps. The edges of the wound in the gall bladder are stitched with the continuous suture to the upper end of the wound in the abdominal wall, leaving the opening into the gall bladder quite free. A drainage tube should be inserted. Finally the rest of the abdominal wound is closed as usual by sutures through the whole thickness of the wall, including the peritoneum. If a calculus cannot be extracted from impaction in the duct, an attempt may be made to dislodge it by external manipulation, or it may be crushed *in situ* with padded forceps. The ducts should be examined to see if they be pervious before closing the wound.

Paracentesis Abdominis.—*Instruments required.*—1. A trocar and canula. 2. Catheter. 3. Aspirator. 4. A broad flannel bandage split at the ends into three, and having a hole at the spot where the operation is to be performed. 5. Brandy, ether, and ammonia. 6. Basins. 7. Blunt pilot to clear trocar if blocked. 8. Lint and collodion. 9. Lund's oil. 10. Roller. 11. Scalpel. 12. Acupressure needle and ligature. 13. Subcutaneous syringe.

Preliminary Steps.—Empty the bladder with a catheter, and ascertain that the part to be punctured is dull on percussion and contains fluid.

Position of Patient.—He should be placed on his side, and the broad flannel

bandage applied round the abdomen and entrusted to an assistant to tighten and maintain the pressure whilst the fluid is evacuated.

Place to Tap. — In the median line midway between the symphysis pubis and umbilicus, in order to avoid the internal epigastric artery.

Operation. — A preliminary incision through the skin may be made with a scalpel at the spot indicated, but this is not really necessary. The trocar, well oiled with Lund's oil and ensheathed in its canula, is held by the surgeon in his right hand, with the forefinger placed on its side to regulate the depth of the puncture. The operator now plunges the instrument with one bold push into the abdomen, at the same time giving a twisting motion; directly all resistance ceases the trocar is withdrawn and the canula pushed home. An india-rubber

tube fixed to a side branch of the canula is useful to carry the fluid away. If the current stop, pass the blunt pilot through the canula. When all the liquid is evacuated the canula is withdrawn with a slight twist, a pad of lint fixed over the wound with collodion, and a broad pad and bandage applied to the abdomen outside this.

Dangers.—1. Syncope. This is prevented by the use of the flannel bandage and the administration of stimulants. 2. Hæmorrhage. This can be arrested by an acupressure needle passed through the whole thickness of the abdominal parietes, and compression effected by a twisted suture. 3. Wound of the intestine, which is not likely to occur if the operation be properly performed, and which must be treated on the usual principles.

SECTION IX.

THE SKIN AND APPENDAGES.

CHAPTER XXXIX.

SURGICAL DISEASES OF THE SKIN.

Clavus, or Corn, is a local hypertrophy of the epidermis, produced by intermittent pressure or friction. In some cases there is an hereditary tendency to the formation of corns.

Situation.—Most commonly met with on the feet from too tight or badly fitting boots, but may be seen on the hands, knees, or elbows in those whose occupations expose them to pressure of those parts; also on the crest of the ilium as the result of tight stays.

Varieties.—Corns are divided into hard and soft. *The hard corns* are of two kinds. In the most common form the condensed epithelium is flat and horizontally laminated; in the other variety, or fibrous corn, the epithelium is arranged vertically, enclosing an elongated and thickened papilla; it is most commonly situated on the sole of the foot or ball of the toe. When a corn is of long standing a bursa may form underneath it.

Soft Corns.—The epithelium covering

these is soft, white, and moist. They are more sensitive and vascular than the hard ones, and have a papillary structure. They are found generally between the toes, as the result of narrow soles.

Accidents which may follow are inflammation, especially of the bursa under the corn, erysipelas, lymphangitis, ulceration, gangrene, and suppuration of the subcutaneous tissue. When the corn is fibrous and situated on the sole of the foot, if suppuration ensue beneath it, the pus, unable to make an opening for itself through the hardened cuticle, progresses upwards and points on the dorsum of the foot, forming one variety of perforating ulcer of the foot.

Treatment.—Remove all pressure, and see the patient has properly fitting boots; in some cases a cloth or buckskin boot affords much relief. Soap plaster spread on leather, with a hole in its centre situated over the corn. The corn may be touched with a drop or two of glacial

acetic acid again and again, and the cuticle scraped away with a knife, scissors, or file; nitrate of silver or tr. iodi. may then be applied to the exposed surface of the cutis, the feet being washed night and morning with soap and water, and rubbed well with a soft towel. Lint soaked in a solution of carbonate of soda and covered with oil silk will also soften the corn. Salicylic acid as a plaster, or dissolved in collodion, is very useful (salicylic acid ʒij, collodion ʒvj). In old-standing cases, after the cuticle is softened, the centre of the corn is isolated by a small sharp knife or scissors, raised by a hook or forceps, and its base cut through, taking care not to touch the sensitive skin under the corn. If suppuration occur the cuticle must be softened by warm-water dressing or poultices, and the pus let out by puncturing with a lancet; opium should be given internally. In the fibrous corn, which usually arises in young people, apply potassa fusa or a poultice and blister; should there be a perforating ulcer of the foot, pass a seton through the ulcer and out at the sole.

For soft corns the best applications are oxide of zinc and starch as a dusting powder, wrapping the toe in cotton wool; concentrated nitric acid; nitrate of silver; tincture of iodine; collodion; acetic acid; equal parts of spirit and water with alum.

Warts, or Verrucae, are hypertrophy of the papillæ of the skin surrounded by epithelium and occasioning small growths. They are of two kinds, acquired and congenital. *The Congenital* form is not very common; the warts form irregular patches of a dark appearance, unsymmetrical in distribution, and surrounded by healthy skin.

The Acquired Warts.—The common wart, or *verruca vulgaris*, appears as a small tubercular elevation, at first smooth on the surface, and then rough, granular, or nodulated, with depressed lines, which may even form fissures. The base may be sessile or pedunculated, and the surrounding skin is healthy. Warts may affect any part of the surface, but are most commonly situated on the hands, face, and neck, and occur particularly in childhood before puberty. They may appear suddenly and as suddenly disappear.

Verruca Necrogenica is that form of wart which is common in those who perform antopsies.

Verruca Senilis is met with in old people, especially on the dorsal aspect. They are softer, flatter, darker, and more greasy than the common variety; in some cases in the more advanced periods of life they may take on a carcinomatous action.

Veneræal Warts result from the irritation of gonorrhæal or acrid discharges, and often form large cauliflower excrescences. They are pointed at the summit and usually pedunculated, which distinguishes them from condylomata, which are flat and non-pedunculated.

Treatment.—Destruction by caustics, as glacial acetic acid, nitrate of silver, tincture ferri perchlor., nitric acid, chromic acid, carbolic acid, acid nitrate of mercury, arsenious acid ʒj in nitric acid ʒss, tincture of iodine, or saturated solution of potassa fusa in water. For soft warts, salicylic acid dissolved in collodion, as recommended for corns. In some cases a ligature is useful applied tightly round the base, whilst the wart is pulled forward, by forceps. In cauliflower excrescences, Paquelin's thermo-cautery, or the warts may be snipped off with scissors, and then the cautery applied to the raw surface. Another very good method to remove warts is that of erosion, the wart and adjacent skin being frozen by the ether spray, and then removed with a small steel spoon. An elastic ligature is sometimes of service.

Onychia, or inflammation of the nail-bed or matrix, may be simple or syphilitic.

Simple Onychia is most frequent in strumous children under ten, but is met with at all periods of life. It is most commonly excited by a local injury, as a pinch; crush, or splinter. The finger end swells and pus is effused under the nail, which becomes loosened, dark-coloured, and shrivelled; as it grows it turns upwards from its bed, exposing an obstinate ulcer, with a brown glossy surface, very painful, and discharging a fetid discharge. The finger end is enlarged and bulbous, and the surrounding skin dark, red, and inflamed. The slightest touch causes exquisite agony. As a rare event, necrosis of the phalanx may occur.

Treatment.—Hot or cold applications at first to the finger, according to the feelings of the patient. Afterwards black wash, or a lotion of liq. arsenicalis (ʒij to ʒj); or nitrate of lead ointment, iodo-

form, or boracic acid may be used instead of the lotion. Chlorate of potash and bark internally with appropriate constitutional treatment, as cod-liver oil and sulphide of calcium in strumous individuals. I have found small doses of opium in the form of Dover's powder very beneficial. In obstinate cases the patient should be anæsthetised, and the matrix removed with nitric acid or the knife.

Syphilitic Onychia is less acute. It may affect the fingers or toes, and often several nails are implicated. The parts at the base and sides of the nail become painful, swollen, and dusky red; suppuration occurs, and unhealthy ulceration follows, with loosening of the nail; after its separation, thick white epidermic scales are deposited at the base and sides from an abortive attempt to form a new nail. Ulcerative fissures may form between the digits (rhagades digitorum). Other symptoms of syphilis will be present.

Treatment.—Remove the nail, apply nitrate of silver, followed by black or yellow wash, or iodoform ointment. Internally give calomel and opium, or bichloride of mercury with bark or sarsaparilla. Iodide of potassium in large doses is often useful, and Donovan's solution in obstinate cases.

In-growing Toe-nail occurs in the great toe, the outer side of the nail being embedded in the soft parts; the inner side is rarely affected. It is caused by the soft parts being pressed on and made to overlap the nail as the result of overcrowding the toes in a narrow-pointed boot, or by the projecting corner being cut away too deeply at the outer angle. Tenderness is produced, followed by inflammation, swelling, and ulceration; the ulcer is covered with fungous sensitive granulations, and secretes a fœtid bloody discharge. In some cases the whole toe is acutely inflamed. Great pain and inability to walk are occasioned by this obstinate affection.

Treatment.—If the disease be slight, oiled cotton wool, or a piece of sheet lead, may be inserted with a probe between the edge of the nail and the overhanging soft parts, and fixed by strapping; the soft parts are also drawn away by strapping, and the granulations touched from time to time with nitric acid or nitrate of silver. Boots must be worn which will give plenty of room for the foot, and the nails be cut square. Another plan is to

scrape away the edge of the nail so as to make it very thin and lessen the pressure. If the disease be of long standing or severe, Cotting's operation, or avulsion of the nail, may be performed. Cotting's operation consists in removing with the knife, whilst the patient is anæsthetised, the diseased fleshy parts, together with a thick slice of the adjacent healthy tissue of the toe; the piece thus shaved off is limited by the side of the nail, which must remain undisturbed, and subsequently is left quite free by the contraction which attends cicatrisation. The dressing employed is lint or absorbent cotton firmly compressed by means of a narrow roller, and covered with oil silk. Avulsion of the nail, or rather the outer third of the nail, is performed under an anæsthetic; one blade of a pair of scissors is pushed beneath the nail well into the matrix on a line with the incurvated edge; the offending portion is then removed by cutting the nail and using a pair of torsion forceps. The bleeding is slight, and the raw surface can be dressed with water dressing or iodoform; and if the granulations be exuberant, powdered nitrate of lead, oxide of zinc, perchloride of iron, sulphate of copper, and nitrate of silver are useful.

Keloid or Cheloid is a hypertrophic outgrowth of the fibro-cellular tissue of the skin. It may be traumatic or idiopathic. The *traumatic or cicatricial keloid* occurs in scars, particularly those resulting from burns and scalds, syphilitic ulcers, and wounds caused by flogging, and appears to depend on some unknown constitutional idiosyncrasy. The scar tissue increases, especially in depth, forming elongated prominent elevations of a semi-cylindrical shape, with a well-defined rounded border, and a slightly convex or centrally depressed surface. The colour is purple, from the large supply of blood vessels, but as it becomes older this fades away into a pinkish hue. To the touch it feels elastic and firm. In the course of time the growth ceases to increase, rarely exceeding half an inch in thickness. It is liable to ulcerate. Sometimes this variety will disappear spontaneously.

The *idiopathic or spontaneous form* may occur on any part of the body, but is most common over the scapula and sternum, and rarely met with in the lower limbs. It commences as a firm,

hard, prominent, shining, palish-coloured nodule on the skin; this sends out processes or claws, which contract, puckering in the skin towards the centre. Finally, it forms a tumour two or three inches in length, having an oval outline, with a flattened surface, which may be centrally depressed, and a hard resisting consistence. It is generally of a white colour, but sometimes pink. The growth is not painful, but a sensation of heat and itching is often present in the early stages. It is usually single in this form, but in the cicatricial variety multiple. Negroes are especially liable.

Treatment.—Chloride of ammonium, iodide of potassium and cod-liver oil internally. Tincture of iodine, colloidion, or ointments of iodine, or some iodide externally. If excised it will return and become larger. Balmanno Squire recommends repeated linear scarification. The disease is generally very obstinate.

Malignant Pustule, Charbon, or Anthrax, in man, is derived from some poison generated in animals, as oxen, sheep, goats, horses, donkeys, rabbits, hares, etc., suffering from splenic fever. The poison is connected with the appearance of a large bacillus (bacillus anthracis).

Cause.—Direct contact with hair, hoofs, horns, hides, bones, flesh, or blood of diseased animals; also by indirect contact, as the straw of the litter, hurdles, splinters of wood, articles of clothing, flies and other insects that have been in contact with diseased animals, etc. It has been seen in persons who have eaten the flesh of infected animals.

Symptoms.—The disease attacks exposed parts of the body, as the face, neck, and hands, and is at first a purely local affection.

Local Symptoms.—In one to three days after infection, or at a later period, a small red spot, like a flea-bite, appears, which is preceded by itching. In twelve to fifteen hours this changes to a vesicle containing brownish red or yellow serum. This bursts, and the subjacent skin is seen dry, of a black colour, due to localised gangrene of the true skin. Within the next twenty-four hours, round the discoloured spot, which is depressed, a fresh crop of vesicles appear. One to two days after, the parts beneath swell and form a solid well-defined lump, easily

raised from the surrounding tissues (tumeur charbonneuse); the indurated area may have a diameter of more than an inch; around this a diffuse and soft œdema, gradually fading away into healthy tissue, is seen. The central slough enlarges, and fresh vesicles appear round it; it is very hard, and the skin round about it is of a livid red colour. Lymphangitis is very often present. *There is little or no pain.* Pus is never formed until separation of the slough occur. In some cases there is only œdema (malignant œdema) without local gangrene and with few if any vesicles.

Constitutional.—Rigors; headache; tongue coated with white fur; bowels confined; appetite lost; temperature often high, but subject to rapid changes; pulse full, soft, and rapid; followed by symptoms of collapse; cold sweats; vomiting; coldness of the surface; dyspnoea; thin, weak, thready pulse; faintings; cyanosis. In some cases, severe nervous symptoms, with convulsions and tetanic spasms, followed by coma. Broncho-pneumonia or gastro-enteritis is common. The disease may be first internal and then local.

Course runs from four to nine days.

Prognosis.—If treated early, favourable; if neglected, very unfavourable, death occurring in five or six days.

Treatment.—Complete removal of the whole indurated area and a small portion of the adjacent healthy tissue by the knife and caustics, as caustic potash. A very supporting general plan of treatment. In cases which recover, the bacilli are present in the saliva, sweat, fæces, and urine. The wound should be dressed with carbolised oil, or perchloride of mercury. The subcutaneous injection of bichloride of mercury solution, or carbolic acid, has been successfully employed. To combat the cyanotic tendency, ammonia and brandy. Sulphite of sodium in 10 gr. doses has been recommended, and also quinine. If œdema glottidis occur, laryngotomy.

Lupus is a disease in which a new growth, resembling granulation tissue, invades the skin in the form of an infiltration or of tubercles. It is most common in strumous individuals. Lupus presents itself in three forms:—Erythematous, tubercular, and exedent. This disease is seldom hereditary, and never contagious.

Lupus Erythematodes occurs in healthy

individuals, generally of the female sex. It is most frequent in the middle period of life, and very rare before puberty. The disease progresses most quickly in cases where there is mental anxiety or worry. Other causes are exposure to cold winds, sudden changes of temperature, and exhausting discharges, as menorrhagia and leucorrhœa. It is a superficial lupus, which commences in and about the walls of the sebaceous glands, which become condensed by accumulation of cells and connective tissue. The follicles are converted into globular bodies, with granular contents, and finally disappear.

Symptoms.—It begins as a red patch, usually on one cheek, by the side of the nose, only slightly elevated, at first temporary and then permanent. This is studded with comedo spots, which are the openings of sebaceous follicles. After a while desquamation ensues, the patch becoming covered from the centre outwards with small white scales, or thin crusts of a yellow or grey colour, composed of epidermis and dried sebaceous secretion. Later, the scales and crust separate, leaving a thin, polished, white, indelible scar. The cicatrization is the result of interstitial absorption, and is unaccompanied by ulceration. A similar patch will generally form on the other cheek and over the bridge of the nose, giving a butterfly appearance. The scalp and fingers are sometimes attacked. The disease tends to spread either by increase at its periphery, or by the formation of fresh patches and the union of these.

Lupus Pustulosus is a variety of the preceding form, attended with the formation of pustules, which rupture, producing a whitish yellow or dark brown crust, on detaching which a ragged shallow ulcer is seen. The crusts fall off, leaving a white, depressed, thick, opaque scar.

Lupus Tuberculosis vel Vulgaris is characterised by the presence of distinct tubercular elevations, forming an isolated patch. It generally appears before puberty, attacks the nose and face, and is associated with struma. It commences on the cheek as a cluster of small tubercles of reddish yellow or pale amber colour, soft and gelatinous, looking like apple jelly, and very vascular, but not painful. This may remain stationary for months, or even years; then it enlarges

at the circumference, presenting a flattened irregular surface, of a dull red colour, with a well-defined margin, which is the seat of fresh tubercles in the direction of its growth. It is generally accompanied by a greater or less degree of infiltration of the subjacent and adjacent cellular tissue. Crusts may form on the surface, or scales adherent in the centre, and detached and curled at the edges. The growth, after a varying period of time, undergoes fatty degeneration, and is absorbed, leaving small white superficial or depressed cicatrices. The patient's health is unaffected, and the disease is extremely slow in its progress. Demme, in 1883, discovered a bacillus identical with the bacillus of tuberculosis, among the lupus cells.

Lupus Exedens, or Noli Me Tangere, is the ulcerative form of lupus tuberculosis, and generally affects the nose, beginning in the alæ, the tip, or column of the nose, and attacking the skin or mucous membrane, or both these together. It is most common about the age of puberty, and more frequent in females than males. It chiefly affects persons with the strumous diathesis. A similar disease is met with as one of the forms of tertiary syphilis (syphilitic lupus). It commences as in the ordinary form, but the tubercles soon suppurate and become covered with a crust, beneath which is an ulcerated surface. Fresh tubercles appear at the circumference of the ulcer, and undergo a similar change. The ulcers at first assume the shape of the patch of tubercles, but afterwards extend, destroying the cutis, subcutaneous cellular tissue, and in the nose the cartilages and nasal bones. The borders of the ulcers are abrupt, irregular, jagged, and slightly elevated. The surrounding skin is more or less reddened, but not swollen or hard. The base may be covered with prominent dusky granulations, or be comparatively pale or greyish yellow, with only a few granulations. If the eyelids be attacked, both the skin and the conjunctival surfaces are implicated, and the whole lid may be destroyed. In other cases the mucous membrane of the nose is the primary seat, this becoming swollen and vascular; an ulcer forms, covered by a crust, and spreads, perforating the septum. There is itching, but not much pain. The disease is increased by indiscretions in diet, expo-

sure to cold and wet, and during menstruation.

Consequences.—Always obstinate and tenacious; if untreated, the disease may lead to the destruction of the whole nose, eyelids, more or less of the lips, and pinna of the ear. If treated, the scars which result vary in appearance according to the depth of the ulceration, and much resemble those of burns, having a like tendency to contract and produce deformities, such as ectropion, etc.

Treatment.—In all forms of lupus good air, especially bracing sea air; good living, a plain meat diet with fresh vegetables, avoidance of tea, but a glass or two of good wine with the meals. Abrath's fresh raw arterial blood treatment is very serviceable. Cod-liver oil, iron, especially in the form of Parrish's food, and quinine are necessary. In the erythematous variety, dusting powders, as oxide of zinc and starch, or bismuth; soap well applied to the part with a flannel, rubbed to lather and washed off, and then the dusting powders. Lotions, either borax (3j to 3vij), with hydrocyanic acid dil. (3ij), or oxide of zinc (3ij); calamine powder (3ss), glycerine (3ij), rose water (3vj); the liquor plumbi is useful. An ointment of oleate of mercury 5 percent. gr. xx, salicylic acid gr. xxx, lard 3j is valuable. If the disease be limited and not of long standing, blistering the part. When there is much desquamation, a weak solution of nitric acid, or iodine in glycerine, with iodide of potassium, or chrysophanic and pyrogallic acids. Scarification and erosion. Internally, arsenic, in the form of liquor arsenicalis, or Donovan's solution; iodine; iodide of potassium, or sodium; phosphorus; iodide of starch; cod-liver oil. In the tubercular form,—locally subdue all inflammation by the above-mentioned remedies, and then give an anæsthetic, and scrape away all diseased parts with a Volkmann's spoon; after this operation, any patches that return can be touched with the galvanic cautery. Many surgeons destroy the growth with caustics, as caustic potash; acid nitrate of mercury; nitrate of zinc (one part), bread mass (two or three parts); nitric acid; chloride of zinc, etc. These should only be applied to the edge of the patches, and not over too extensive a surface at one time, as the caustic causes sharp inflammation for three or four days. Hebra treated lupus by

nitrate of silver in toughened sticks with sharp points, which are thrust into the diseased patches; there is little or no bleeding. Of late two caustics have been used which possess great advantages, namely, pyrogallic acid in the form of an ointment (20 per cent.), used twice a day, followed by a mercurial ointment. This does not cause much pain, and is very good for slight patches where the skin is loose. The other caustic is salicylic acid, which will attack the lupus patches without affecting the skin. The pain of this application is very great; to mitigate this, creasote is mixed with it (Unna). It is applied in the form of an ointment, salicylic acid (1 part), creasote (2 parts), lard and wax (2 parts); this is a most useful application after scraping, pain ceases in from ten to twenty minutes after the ointment is applied, and may be relieved by cocaine (Unna). Baths containing iodine, sulphuret of potassium, sea-weed, sea salt, or carbonate of soda are useful. Internally, iodide of iron, iodide of potassium, and mercury. A measure which is often useful is to freeze the patch with the ether spray, and perform punctiform or linear scarification, as recommended by Squire.

In Exedent Lupus.—Locally. Subdue inflammation. Caustics to the raw surface after the scab has been removed by forceps or poulticing. The caustic must be applied thoroughly to the part, whilst patient is anæsthetised, either by the galvanic cautery, the actual cautery, Paquelin's thermo-cautery, gas cautery, strong nitric acid followed by nitrate of silver, or chloride of zinc in the stick. Scraping may be used, instead of caustics. As after-dressings, ointments of biniodide of mercury and lard; red oxide or ammonio-chloride of mercury; or ointments of lead, zinc, and nitrate of mercury, in equal parts.—Internally. Iodide of potassium, Donovan's solution, or a pill of iodide of arsenic $\frac{1}{8}$ gr., with biniodide of mercury $\frac{1}{12}$ gr., or one of calomel and opium.

Rodent Ulcer, or Jacob's Ulcer, rarely occurs before the age of fifty, but may appear as early as forty. It affects both sexes equally, and persons who are apparently in good health. It commences as a hard, solitary, indolent, reddish brown tubercle, situated at some part of the upper two-thirds of the face,

either on the cheeks, eyelids, or a^lae of nose, or scalp. The tubercle slowly increases in size, with a hard margin, and after a time, may be two or three years or longer; cracks, the fissure being at first concealed by a scab, but as the ulceration progresses, the raw surface of the ulcer projects beyond the scab. The ulcer, when formed, is irregular and sinuous, bounded by somewhat raised and slightly elevated edges, which are abrupt or rounded off, and not undermined or everted; the surface is smooth, cleanish, with a pinky, dry, and waxy look, *without* granulations. The skin around is supple and healthy. The discharge is thin and scanty. The glands are not involved, nor the patient's health. The disease progresses often at a very slow rate, increasing in depth and extent, destroying all the surrounding tissues; the soft parts are eaten away, the bones, mucous, fibrous, and glandular tissue, with the production of a ghastly, yawning, huge chasm. In the early stage there is little pain or hæmorrhage. The disease does not return after complete removal, but if untreated is always fatal, as it never heals spontaneously, though imperfect attempts at cicatrization may be seen in parts.

Pathology.—The ulcer is preceded by infiltration of the surrounding tissues by a thin line of new cells, resembling epithelial tissue of a rudimentary kind. These cells are smaller than those of epithelioma, and are contained in alveoli. The disease arises from the glandular epithelium of the secreting organs of the skin, and progresses deeply by flask-shaped outgrowths, which never contain epithelial globes.

Diagnosis.—From epithelioma it is distinguished: 1. By its slow growth; 2. Partial attempts at cicatrization; 3. Situation; 4. Non-involvement of the lymphatic glands.

Treatment.—Complete removal by caustics, the knife, or both these methods. The knife may be used to excise the ulcer when situated on the cheek, eyelid, eye, and forehead; but generally escharotics are to be preferred, as being less liable to be followed by accidents. The best caustics are Canquoin's paste (chloride of zinc, 1 part; flour, 2 parts; water, q.s.); Vienna paste (potassa fusa and slaked lime, equal parts; spirits of wine, q.s., mix); London paste

(lime and caustic soda, equal parts); Frère Comé's (arsenic, 1 part; cinna-bar, 4 parts; charcoal, 10 parts): these are very useful if the ulcer be large and deep. If large and superficial, acid nitrate of mercury or nitric acid is most serviceable. When small, the following caustic, calomel ʒijss, bisulphide of mercury ʒij, arsenious acid ʒj, mixed into a paste with water. When the ulcer is of very large size and depth it must be extirpated by the knife and chloride of zinc combined, and the gap covered with a mask. The actual, galvanic, or thermo-cautery are sometimes of use.

Perforating Ulcer of the Foot.
Causes.—Affections of nerve tissue, either peripheral or more commonly central. The interstitial tissue of the nerves is thickened, whilst the sensory and trophic fibres are absent or degenerated, the larger or motor fibrils being unaffected. It is met with in anæsthetic leprosy, locomotor ataxia, caries of the spine, progressive muscular atrophy, congenital deformities of the foot, and in cases of injury of the nerve trunks and spinal cord. Syphilis is sometimes a cause, and glycosuria often co-exists.

Symptoms.—There is an opening on the plantar surface of the foot, often seated at the base of a corn, over the ball of the great toe, or the outer part of the foot at the junction of the metatarsal bone with the phalanx of the little toe. There may be more than one opening. The mouth of the sinus may be surrounded by granulations, or by extensive ulceration. As a rule there is no pain in the part, except on attempting to walk. The skin is cold, frequently congested, and liable to fœtid profuse perspiration; the sensibility is much diminished, the epidermis thickened, and hair grows thickly. The opening or ulcer leads directly through a narrow sinus to diseased bone, or passes right through the foot. It is accompanied with inflamed bursæ, open joints, and disappearance of cartilage. Eczema and erysipelas may appear from time to time. The nails are yellow, fissured, and curved laterally. Shortening of the foot is sometimes met with, due to disintegration of the metatarso-phalangeal joint, or interstitial absorption.

Treatment.—Prolonged rest, and Fowler's solution. Amputation above

the diseased nerve tissue, by Syme's or Teale's methods. As a palliative, an artificial leg attached to the bent knee, so as to give the foot physiological rest. The disease is very intractable. The galvanic current is worth trying, but must be persevered with for a long time.

SECTION X

THE BREAST.

CHAPTER XL.

DISEASES OF THE BREAST.

Hypertrophy consists in an increase of size, due to increased growth of the normal tissue of the gland. It is rare, and generally commences at puberty; both sexes may be affected. Both breasts are generally involved, but one often more than the other. The general health is good, but in females the catamenia may be irregular. The breast may reach several pounds in bulk. There is but little pain, the growth is slow, and the superficial veins dilated.

Treatment.—Iodide of potassium internally, and friction with oleate of mercury. The breast may be strapped. In severe cases, amputation of the breast.

Inflammation of the Breast v. Mastitis is most common during lactation in the first month after child-birth. It occurs frequently in primiparæ in whom the nipples are defective or cracked. In women who have suckled too long, inflammation is not uncommon, especially when the infant is weaned. It may arise from traumatic causes. New-born children may suffer from abscess of the breast, from nurses squeezing their breasts. The inflammation as a rule proceeds to suppuration, forming an abscess, which may be superficial, intra-glandular, or submammary. The pus always contains micrococci.

The Superficial Abscess which occurs in cellulo-adipose tissue beneath the skin, is always circumscribed. There is not much constitutional disturbance, the areola and nipple are inflamed, and the parts projecting, red, and swollen.

Intra-glandular Abscess may affect part or the whole of the gland. The first symptom is usually a rigor, followed by fever, and occurring a week, fortnight, or

three weeks after delivery. The breast feels hard, tender, and is painful on handling or moving the arm. One or more ovoidal lobules are attacked at the commencement, and one lobule after another may be involved, giving rise to several abscesses. The pain becomes more severe, with throbbing, burning heat. The breast increases in size and weight, and after some days the skin becomes reddened, glossy, tense, and œdematous, pits on pressure, and deep-seated fluctuation can be detected. The milk is arrested or diminished. With the acute pyrexia, occasionally cerebral excitement is present.

Submammary Abscess occurs in the cellular tissue between the mamma and the pectoral muscles; it is sometimes due to the deposit of tuberculous matter. Occasionally submammary abscess arises from caries or necrosis of the ribs, or perforation of an empyema. The breast is prominent and projected forwards. The pain is deep-seated and throbbing, but not so acute as in the previous form; there is often high fever. The abscess, from its deep situation, is slow in pointing, but after a variable time the skin becomes œdematous and slightly red. Fluctuation is obscure until the abscess becomes more superficial; pointing takes place usually at the lower and outer part of the gland, but often several openings are present round the base of the gland. As a rare event the abscess may open into the pleura or anterior mediastinum, or may give rise to pleurisy.

When a mammary abscess is allowed to proceed unchecked, especially if intra-glandular, the matter is prone to burrow, dissecting adjacent lobules from one

another and from the parts in juxtaposition, thus leading to the breast being riddled with sinuses.

Treatment.—When the breast is inflamed, if possible suppuration should be prevented by slinging the breast from the neck by a handkerchief, and fixing the arm to the side.—Locally. Gamgee recommends, when the inflammatory nodule is first perceived, fomentation with very hot water and friction over the whole gland with the outspread hand, smeared with olive oil or glycerine; then pad, suspend, and compress. Warm oil and laudanum are very useful. Glycerine and belladonna smeared over the breast, liniment or tr. of belladonna applied as evaporating lotions, or warm lead and opium lotions, are all serviceable. The gland should be emptied with the breast pump, and the child suckled with the other, or weaned. The general treatment consists in saline purgatives, iodide of potassium, aconite, vin. antimon., low diet, little fluids, ice being allowed to suck to quench the patient's thirst. If suppuration occur, warm fomentations of chamomile and poppy heads or poultices with laudanum. Pain must be allayed by opium. Directly fluctuation is detected, or œdema is observed, the patient should be anæsthetised, and the abscess opened, under aseptic precautions, at the most dependent part by a free incision in the direction of the ducts, and a drainage tube inserted. If aseptic treatment be not adopted after the matter has discharged, poultices may be applied for a few days, and then water dressing and bandaging. The diet must be good, and iron, the mineral acids and quinine are useful; stimulants are requisite in this stage. When there are sinuses a most advantageous dressing is recommended by Dr. Forster of New York. It consists in the application of compressed sponge, which freed of dirt, soft, elastic, and large enough to cover the whole breast, is dried and compressed by placing it under a letter copying press for twenty-four hours; this is applied over the affected breast and fastened by a spica bandage, and then wetted with tepid water, which causes the sponge to swell, affording uniform pressure; the sponge is changed every twenty-four hours. Other but inferior methods of treating the sinuses are by scraping them with a sharp spoon, and injecting stimulating lotions, as

chloride of zinc (gr. xl to ʒj), or tr. iodi. Lint steeped in turpentine is useful. A very effectual method is to firmly strap the breast with semicircular pieces of strapping, and then apply pads and a spica bandage. As a last resource the apertures of the most dependent sinuses may be enlarged with a knife.

Chronic Encysted Abscess is very liable to be mistaken for more serious diseases of the breast. It forms without any observable symptoms of inflammation, is deep-seated, and grows slowly. A hard, indolent swelling appears, in which it may be impossible to detect fluctuation owing to lymph being effused round it, forming a thick wall. It occurs at all periods of life, and is common in young, unmarried women between the ages of twenty and thirty, especially in those who are strumous; it is also frequently met with in married women during pregnancy, or after a miscarriage. In women who are suckling and unable from any reason to use one breast, this affection may attack that gland. The disease generally commences as several hard lumps, which coalesce and unite, forming an irregular, firm mass; as it enlarges it becomes softer, and fluctuation may be detected. There is little or no pain, the skin is not red or discoloured, but the subcutaneous veins are often enlarged, and there may be retraction of the nipple and swelling of the axillary glands. The diagnosis is difficult, but the equality of the surface, the absence of pain, presence of fluctuation or œdema of the subcutaneous cellular tissue, the fact that it is not distinctly circumscribed, nor freely movable, will generally show its nature. If any doubt exist, the swelling should be punctured with an exploring trocar. The disease may last for months without affecting the general health.

Treatment.—Make an incision, scrape with a Volkmann's spoon, insert a drainage tube, and support the breast with compressed sponge or strapping, the arm being supported by a sling. Fresh air, tonics, and attention to the diet and bowels.

Induration of the Breast may implicate the whole or part of the breast as the result of slight injuries, as a blow, or affections of the generative organs. It is due to the cæcal terminations of the ducts being distended with epithelium.

ing often several pounds, without forming any adhesion to the deeper parts. The fluid contents are generally thick and viscid. If the cyst be opened, or ulcerate, the intracystic growth sometimes forms a sprouting fungous mass, this being associated with sarcoma.

Treatment is the same as for adenoma. If conjoined with sarcoma, amputate the breast.

Sarcoma of the Breast, or Adeno-Sarcoma, may be solid or cystic. It may be round-celled, spindle-celled, or myeloid, and may be conjoined with adenoma. The spindle-celled growth is most common, but myxo-sarcoma is often met with. The tumour is generally single, and may be hard or soft, depending on the variety; the hard growth is spindle-celled, the soft round-celled and myxo-sarcomatous; the cystic variety is of unequal consistence. The tumour may be circumscribed and encapsuled, or diffuse. The circumscribed form is generally hard, and commences at the circumference of the breast; its symptoms are similar to adenocele and fibroma. It is most common soon after marriage or pregnancy, between the ages of twenty and thirty, and evinces little disposition to recurrence (Gross). The diffuse form generally begins at the centre of the breast, in the vicinity of the nipple, and is most common towards middle age, though it may be met with at any age. It is round, oval, and lobulated in shape; the skin is movable and not affected for a time, but ultimately ulcerates; the subcutaneous veins are enlarged; as the growth progresses, a fungating tumour is produced, infiltrating the neighbouring tissues, and prone to affect internal organs, as the pleura, lungs, and other viscera. The disease is very apt to return after removal, Gross mentioning a case in which twenty-three operations were performed with eventual success. There is little pain, uneasiness only being caused by the great bulk and weight of the growth. The rate of increase in size varies; in some cases this is slow, in others rapid; or a slow growth may rapidly increase, accompanied by fever. The tumour and breast are freely movable, and do not contract adhesions.

The cystic form is described previously (*vide* Compound Cyst).

Diagnosis.—Gross writes: "On the

whole, diagnosis is based upon the indolent origin, mobility, central situation, elastic or unequal consistence, lobulated outline, rapid increase, large dimensions for the period of their existence, freedom from lymphatic involvement, and marked tendency to ulcerate; upon the not infrequent discolouration of the skin, enlargement of the subcutaneous veins, and possible elevation of the temperature; upon the suffering which they awaken late in the disease; and upon their greater frequency after the thirty-third year." The solid develop about thirty-seven; the cystic about thirty-three, and grows more rapidly. Tillaux writes of the differential diagnosis between sarcoma and carcinoma of the breast: Sarcoma proceeds more slowly than carcinoma, and may remain stationary for some time, even for twenty-five years. Confirmed sarcoma is irregular, the nodules being much greater than those of carcinoma. It does not adhere to the thorax, whilst carcinoma becomes adherent to the skin. Sarcoma may attain an enormous volume, twelve to fifteen pounds. In carcinoma the skin becomes rapidly adherent, slowly in sarcoma. Retraction of the skin usual in carcinoma, distension in sarcoma. The nipple is soon retracted in carcinoma: pressed out in sarcoma, so that its shape can be restored by the hand. Both diseases tend to ulceration. The skin becomes infiltrated in carcinoma and is destroyed, the borders of the ulcer being hard and continuous with the wound; in sarcoma, on the contrary, it gives way by the distension on its inner face of the sarcomatous buds; the borders of the ulcer are small and soft. In carcinoma the consistence is firm, sometimes hard, and sensibly uniform; in sarcoma it is less firm, and there may even be soft parts due to cysts. Carcinoma rapidly blends with the mammary gland; sarcoma remains distinct. The lymphatic glands from the beginning are affected in carcinoma; hardly ever in sarcoma. Carcinoma returns more frequently than sarcoma, and at a distance; whilst sarcoma returns in the cicatrix. In carcinoma there is rapid cachexia; sarcoma remains local. Sarcoma is indolent; carcinoma painful.

Treatment.—Early and free removal of the breast, but recurrence will take place in more than half the cases.

Carcinoma of the Breast is the most frequent form of growth met with in connexion with this gland. The variety most commonly met with is scirrhus, occasionally encephaloid, and very rarely colloid. It is always primary, and generally only one breast is affected. Birkett classifies the disease into three forms: first, the infiltrating kind (scirrhus); secondly, the tuberos (encephaloid); thirdly, the cystic.

Causes.—Carcinoma implicates the breast at all periods of life, from twenty upwards, but commences most frequently from the thirtieth to the fiftieth year, half the cases occurring from forty to fifty. It is nearly confined to women, but occasionally is met with in men. Married women are most liable, but it often attacks the single. All depressing circumstances predispose to it, as distress of mind, loss of blood, intemperance, etc. Irritation from mechanical injury, as blows, squeezes, etc., seems often to be the exciting cause. It rarely commences during pregnancy or lactation, but should it do so the progress is very rapid.

Forms of Cancer.—When it assumes the infiltrated form, the large nucleated cancer cells are arranged in small groups between the fibres or stroma of the gland. The breast is hard, condensed, and incompressible. The whole gland, or a part only, may be affected. As the disease progresses the proper gland tissue disappears, and the various constituents of the breast become harder, more compact, and of a greyish or bluish grey colour. Next the tumour contracts, dragging the neighbouring tissues towards it; it is now of stony hardness. The tuberos variety commences at the axillary border of the gland, and is characterised by the new growth being contained in a distinct capsule; it pushes the breast tissue before it, and this becomes absorbed; contraction does not occur. The cystiform variety is due to the serum which is poured off by the cancerous growth, accumulating in the tuberos form, between the capsule and the outer surface of the tumour, and distending this so that it forms a cyst within which is the carcinoma. Paget has drawn attention to the fact that cancer of the breast is sometimes preceded by an eczema or dermatitis of the mammary areola. He describes it

as having the appearance of a florid, intensely red, raw surface, very finely granular, as if nearly the whole thickness of the epidermis were removed: like the surface of very acute diffused eczema, or like that of an acute balanitis. From such a surface there is always copious, clear, yellow, viscid exudation (Paget's Disease).

Symptoms of Scirrhus.—(1st Stage.) The disease begins on the surface, within the substance, or at the periphery of the breast. The tumour is at first small, hard, movable, circumscribed, with little or no pain. As it grows it becomes harder, knobbed, irregular, and firmly fixed to the gland and adjacent parts, as the pectoral muscles. It projects externally, giving rise to lancinating neuralgic pains, shooting through the tumour up the shoulder and down the arm, and worse in the night.—(2nd Stage.) The skin becomes adherent, then reddish or purple, then a crack forms and scabs over; this spreads, occasioning an ulcer with raised and everted edges, and a hard nodular, warty, or sinuous margin. The base is hard and nodular, of a greyish green colour, or covered with coarse granulations, uneven, deepest at the centre, apt to bleed, and discharging a thin, acrid, fœtid pus. In other cases the skin is chiefly implicated, being infiltrated with cancer, becoming of a reddish colour—though in rare cases there is no change of colour—and converted into a hard, brawny, rigid substance, often extending over one side of the chest and forming a stiff cuirass. Occasionally the skin becomes affected in another way by the formation of a scirrhus nodule at the outer border, which spreads inwards. Retraction of the nipple only occurs in scirrhus, and not in encephaloid, and is most marked when the infiltration is central; as it does not occur in all cancerous cases, and is met with now and then in adenoma, it is not conclusive evidence. Along with retraction there is a deep groove round the base of the nipple, which Gross considers almost characteristic. There is a form of scirrhus occurring in old persons which is termed atrophic scirrhus; it is characterised by the smallness of the tumour, which does not exceed a walnut, is remarkably hard and dense, and often remains stationary for years.—(3rd Stage.) The axillary

glands are enlarged early in the disease, but after the skin is affected the infiltration advances rapidly; in examining for these the arm should be pendulous. After a time the supra-clavicular and sub-clavicular glands are attacked. Sometimes the primary growth remains stationary, whilst the axillary growth advances with rapidity. When the glands are affected the arm and shoulder become œdematous from pressure on the lymphatic and veins, causing great pain and numbness. Serous effusion into the pleura of the same side may present itself, and secondary affection of the liver is prone to occur. Cancerous cachexia ensues when the skin is involved. Hæmorrhage sometimes happens, but as a rule is not profuse.

Duration.—The disease varies greatly in its rapidity, but the average time in which it proves fatal is three years, and it generally proceeds very slowly in the aged.

Cause of Death.—Exhaustion, septicæmia, hæmorrhage, affection of internal organs.

Encephaloid occurs in about 5 per cent. of all cases. It begins in the substance of the gland as a soft, round tumour, which rapidly grows. The skin and breast tissue is pushed forwards, but not at first adherent, and the superficial veins are enlarged. The glands are not so soon implicated as in scirrhus, and the subclavicular and cervical glands may escape altogether. The tumour is of varying consistence; hard and knotty at some parts, at others soft, elastic, and fluctuating. There is usually no retraction of the nipple. After a time the skin becomes red and gives way, forming a circular ulcer with sharp and undermined edges, through which a fungous mass protrudes of a reddish brown colour, readily bleeding (fungus hæmatodes), and discharging a fœtid bloody pus. This is followed by glandular infiltration and cachexia. The ulcer of carcinoma has no tendency to heal. The disease reaches the size of a child's head in a few weeks. Death results from hæmorrhage, hydrothorax, pneumonia, pleurisy, or pulmonary œdema, and occurs in from six months to one year.

Diagnosis.—It is important to distinguish carcinomatous disease from non-malignant diseases. The chief points to be noted are: 1. The condition of the

nipple and the discharges therefrom. It is retracted in some forms of cancer, but this may also occur in non-malignant disease, and is not pathognomonic. Discharges from the nipple are important; if bloody, offensive, opaque, and containing large nucleated cells, the disease is probably cancer. If clear and serous, it depends on a cystic or adenoid growth. If mucoid, it is caused by a duct cyst.

2. Condition of the neighbouring glands. In cancer these are enlarged, indurated, and fixed, and the lymphatics are indurated. In non-malignant growths they are of the usual size, or slightly enlarged and movable; the lymphatics are not affected.

3. Feel of the tumour.—Cancer: stony hard, nodulated, and distinctly circumscribed. Non-malignant: moderately hard, irregular, not distinctly circumscribed.

4. Mobility.—In cancer the tumour is at first mobile and then firmly fixed. Non-malignant growths are very mobile.

5. Skin.—In cancer this is early affected. In non-malignant growths generally normal. The veins are much dilated in cancer, but not so much in other diseases.

6. Pain.—Severe, shooting, and paroxysmal in cancer; in non-malignant diseases usually slight, except in induration of the breast, when it is widespread over the back, neck, and arm.

Treatment is either palliative or radical. The palliative is only used in cases in which it is not advisable to remove the tumour, and consists in supporting the patient's health with a nutritious diet, and giving opium or some other anodyne in full doses to relieve pain. Tonics, as tr. ferri perchlor., quinine, and vegetable tonics as calumba. Arsenic is of service. Stimulants are often required. The bowels must be regulated.

Locally.—Sling the breast. Belladonna plaster or powdered conium spread on cotton wool. Conium and belladonna ointment. Aconitine ointment provided there be no surface wound. If there be ulceration, lotions of permanganate of potash, chlorate of potash, terchloride of carbon, solutions of chloride of zinc, carbolic acid, combined with morphia; or solutions of opium and belladonna. Gross recommends chloral hydrat. gr. v. cosmoline ʒj. Cocaine in solution painted on the part or used as a spray often

gives relief. Morphia and iodoform ointment. Carded oakum, and Gamgee's antiseptic pads, are serviceable dressings. To relieve œdema Martin's elastic bandage is useful, and elevation of the limb. Dilute tincture of iodine is sometimes beneficial. To stop hæmorrhage, hot water, the ice bag, ol. terebinth., actual cautery, pressure, tannin, solution of perchloride of iron, sulphate of iron, and acupressure.

Caustics are useful in the anæmic, aged, or when the growth has ulcerated. Glacial sulphuric acid made into a paste with powdered saffron is of service for a fungous growth; the Vienna paste and chloride of zinc are also efficacious. Felix's caustic paste is easily manipulated and does not cause severe pain:—

Starch gr. xxxvij
Wheat flour gr. cxii
Bichloride of mercury gr. j
Dry chloride of zinc gr. cx
Iodol (pure) gr. x
Croton chloral gr. x
Distilled water sufficient to form a homogeneous paste.

During the application of caustics the patient may be anæsthetised if necessary.

The Radical Cure consists in amputation of the breast and removal of all implicated glands. It should be performed when the health of the patient is not much affected, the patient is of middle age, the skin is entire, and the axillary lymphatics not much involved. Slight ulceration of the skin, the other circumstances being favourable, is not a bar to operation.

Amputation of Breast.—Instruments, etc., required.—1. Scalpel. 2. Artery, torsion, and compression forceps. 3. Tumour forceps. 4. Dissecting forceps. 5. Double hooks. 6. Blunt hook. 7. Tenaculum. 8. Fine ligatures. 9. Half a yard of stout whipcord to ligature irremovable glands. 10. Wire, silk, or catgut sutures. 11. Absorbent cotton and lint. 12. Strapping. 13. Sponges. 14. Esmarch's irrigator. 15. Scissors. 16. Bandages. 17. Compresses. 18. Anæsthetic and inhaler. 19. Waterproof sheet. 20. Chloride of zinc solution. 21. Hot water. 22. Turpentine. 23. Aseptic dressing.

The patient is placed on her back, inclined somewhat towards the opposite side, and the arm abducted. The subclavian artery may be compressed against the first rib if there be any danger of

hæmorrhage. Under aseptic precautions two elliptical incisions are made, one on each side of the nipple in the direction of the fibres of the pectoralis major, and enclosing a piece of skin varying in breadth according to the circumstances of the case. The lower incision is made first, and the skin dissected off, the gland being then detached from the fascia covering the pectoralis; then the upper incision is made and deepened down to the pectoralis, the knife being kept towards the tumour. The breast is then removed by dividing the loose cellular tissue with a few strokes of the knife, while the gland is drawn from the chest wall. If it be adherent to the pectoral muscle a portion of this must be removed. When the glands in the axilla are involved the incision must be extended and the glands isolated with the handle of the knife or the fingers, and torn out. Mitchell Banks writes: "In every case where the breast is removed the axilla should be cleared out as a necessary accompaniment." Küster advocates the removal of the glands *in all cases*; in 117 cases he found only two in which the glands were free from disease. Mitchell Banks advises after the breast is excised the wound should be brought together as far as possible and protected from cold by gauze. After this, an incision should be carried into the axilla, about $1\frac{1}{2}$ or 2 inches below the edge of the great pectoral; the axillary fascia being opened, the knife should at once be laid aside, and the armpit cleared out with the aid of two pairs of very strong broad-pointed forceps and a dissecting tool. The first thing to do is to lay bare the axillary vein, after which there is no risk in removing the glands. Should these be adherent, the vein must be tied above and below the disease, and the affected part removed. The wound is stitched, a drainage tube inserted at the highest part of the axilla, and a counter-opening made half way down the axilla, and another drainage tube inserted. Sponge dressing is employed wrung out of an antiseptic. This is the best method, but some surgeons draw down the glands which cannot be removed on account of adhesions, and throw a ligature round the pedicle. Bleeding during the operation is to be controlled by seizing each vessel as divided with forcipressure for-

ceps, the vessels being afterwards ligatured or twisted. Capillary or venous hæmorrhage is best stopped by hot water, pressure, turpentine, and chloride of zinc solution.

After-treatment.—The edges of the wound are brought together by attending to the position of the arm, and a drainage tube inserted. If necessary, sutures may be put in both superficial and deep. Should the skin be deficient,

the edges of the flaps may be stitched to the muscles below. The antiseptic gauze dressing, or medicated water dressing, is the best, with the arm supported in a sling.

Death may occur from hæmorrhage, entry of air into a vein, cellulitis, erysipelas, pyæmia, pneumonia, and embolism of the pulmonary artery. In many cases, after a longer or shorter interval, the disease returns in the scar.

SECTION XI.

CONGENITAL AND ACQUIRED DEFORMITIES.

CHAPTER XLI.

DEFORMITIES.

Cleft Palate may exist in various degrees. There may be a double cleft of the alveolar margin with a fissure running backwards and inwards on each side, including the intermaxillary portion of the upper jaw. These may join a single median fissure through the hard and soft palates; the three forming the letter Y. This is the most severe form. In some cases there is only one alveolar fissure; or the alveolus may be entire; or in slighter forms only the posterior part of the palate is affected, or perhaps the cleft may be confined to the soft palate. In complete fissure the sides of the palate have a perpendicular instead of a horizontal direction. Partial clefts are often very broad. The septum of the nose may be continuous by its lower margin with either side of the cleft, thus shutting off one of the nasal cavities from the mouth; secondly, it may terminate in a free border at the lower part, between the edges of the cleft, and be unconnected with the superior maxilla; thirdly, it may be turned up on itself, one of its lateral surfaces looking downwards. Hare-lip is often present. The deformity interferes with deglutition and articulation. Fluids, etc., taken into the mouth are apt to enter the nose, and also cannot be directed over the larynx properly; the speech is guttural, nasal, and indistinct. If a mother complain of a new-born child being unable to swallow, always examine for cleft palate.

Treatment.—The first difficulty to contend with is to enable the child to take nourishment. It cannot suck the breast, so should be fed on the mother's milk drawn into a bottle, the latter having a smooth, flat, ivory pipe attached, and a gutta-percha or india-rubber tongue, to close the cleft during suction. The child should be held upright while it is fed. In some cases a large teat, big enough to fill the aperture, having an opening at its under surface, will suffice. The old-fashioned flat bottle, with a large teat, is a very serviceable article, as by raising the bottle milk is poured into the pharynx. In some cases a small sponge may be soaked in milk and placed in the child's mouth, or the infant may be fed slowly with a spoon passed well back into the mouth. To close the fissure an operation must be performed, but should not be undertaken before the child is two or three years old, and not unless it be in perfect health. When the soft and hard palates are both implicated it is judicious to begin by closing the soft palate first, and after waiting some weeks to operate on the hard palate, as the fissure in the latter often diminishes when the soft palate is made perfect. It is right to observe that Smith, who has great experience in this operation, recommends that the whole cleft should be closed at one and the same time unless there be circumstances of peculiar difficulty in the case.

Staphyloraphy, or operation for fissured palate, may be divided into three stages: 1. Section of the muscles; 2. Freshening the edges; 3. Passing the sutures.

Instruments required.—1. Long-handled narrow-bladed knives. 2. Long-handled curved scissors. 3. Slender hooked forceps. 4. Long-handled small bistoury. 5. Long-handled needles with the eye at the point. 6. Fine silk or catgut. 7. Blunt and sharp hooks. 8. Scissors. 9. Two raspatories curved as an aneurism needle, and one raspatory very slightly curved. 10. Tubular needle with a reel at the base, if silver wire be used, and a wire twister. 11. Ice and cold water. 12. Mackintosh sheet. 13. Sponges on hooks. 14. Smith's gag. 15. Syringe for washing the mouth. 16. Chloroform and inhaler. 17. Coronet with hooks.

The patient must be anæsthetised and the mouth kept open with Smith's gag. The recumbent position is the best, with the head well thrown back and resting on a hard pillow, the mouth being opposite the light.

1. *Section of the Muscles.*—Four muscles act as abductors on each side of the soft palate, but the two most important are the levator palati and the palato-pharyngeus, as these, by drawing the halves of the palate outwards, tend to open the fissure and prevent it healing. The palato-glossus and tensor palati are of less importance. Fergusson showed the necessity for dividing these muscles, and performed the section thus: A lancet-ended knife bent at a right angle is passed back through the fissure, and having been placed on the posterior surface of the soft palate, cuts forward into the substance of the palate in a downward and inward direction. The incision is to be perpendicular to the centre of a line joining the hamular process and the orifice of the Eustachian tube. The hamular process can be felt through the mucous membrane internal, and a very little behind the last molar tooth. The Eustachian tube can be seen through the cleft; by this incision the levator palati is divided, and perhaps the tensor. After section the fissure should be more closed and the palate incapable of being contracted. The uvula is then seized with claw-forceps and drawn forwards to put the

palato-pharyngeus, forming the posterior pillar of the fauces, on the stretch, and this is snipped across for a quarter of an inch with scissors. The anterior pillar, composed of the palato-glossus, is divided to the same extent. Pollock divides the muscles from before backwards. "First, a suture is passed through one section of the soft palate at the root of the uvula, the ends secured together by a knot and held outside the mouth. A similar suture is passed through the other side. One of the sutures is drawn gently forwards and to its opposite side, putting that half of the palate on the stretch. A narrow-bladed knife is then pushed through the soft palate, close to the hamular process, a little in front and to its inner side. Running the knife upwards and backwards, and somewhat inwards, the point is at last seen in the gap, having cut wholly or partially through the tensor palati; the knife should now be above most of the fibres of the levator palati. The handle is now raised, the blade being drawn forwards, while it is at the same time made to cut downwards, dividing the levator palati. The muscles having been divided, the sutures are removed from the root of the uvula." Pollock does not divide the palato-pharyngeus or palato-glossus.

Callender recommended that the section of the muscles should be performed a day or two previous to the other part of the operation.

Smith performs the section of the muscles last of all, drawing up the palate with all the sutures in one hand, and with the palate on the stretch dividing the palato-pharyngeus, and subsequently the levator palati; if the palate will not come easily together he makes two lateral oblique cuts, one on either side above the highest suture, separating the soft from the margin of the hard palate to a small extent.

Bryant advises in some cases that the suture should be introduced first at a quarter of an inch from the free border of the fissure, and secondly, edges pared with scissors the blades of which are at right angles to the handles. To relieve tension, he divides the soft parts laterally.

Tait recommends that the cleft in the hard palate should be closed first, the muco-periosteum being raised with a

raspatory, thus including the tendon of the tensor palati; and after some months unites the soft palate, no division of the muscles being necessary.

2. *Freshening the Edges.*—The tip of the uvula is seized with long claw-forceps, and the edge pared from above downwards, first on one side and then on the other, by means of a narrow sharp knife in a long handle; lastly, the angle of the cleft is freshened.

3. *Passing the Sutures.*—The sutures may be of silver, silk, fishing gut, or horse-hair. A needle with a short curve set in a long handle is threaded with the suture, which must be a yard long, and passed through the soft palate on the patient's left side. The ligature is seized with the forceps and drawn through the cleft and the ends brought outside the mouth; the needle is then withdrawn. Another needle threaded with a double ligature of the same length is passed through the other side of the palate at a corresponding point, the loop of the double ligature is drawn through the cleft and outside the mouth, the needle being withdrawn. The single suture is passed through the loop, which is withdrawn through the palate, carrying with it the first ligature and completing the stitch. This is repeated until all the sutures be in place. To prevent confusion, each pair of threads should be fastened temporarily to a coronet fixed on the head, and having hooks numbered for reference. If silver sutures be used, thread loops should be passed on each side and each end of the wire threaded and drawn through. When all the sutures are applied the ends are tied with a reef-knot without using undue force. If wire be used it may be twisted or clamped in a lead button, or the ends passed through the eyes of a shirt button and twisted. To remove saliva and blood, sponges should be mounted on sponge-holders or on sticks, and simply wiped on a dry towel. The patient must live on a fluid diet for a few days. The stitches may remain until they cause irritation, which is generally from the eighth to tenth day. The acquisition of the power of speech is generally tardy.

Uranoplasty, or closure of the fissure in the hard palate, should not, as a rule, be performed at the same sitting as the

operation on the soft palate, but some time subsequent to this. This operation was introduced by Avery, and is divided into three steps: 1. Freshening the edges; 2. Formation of the flaps; 3. Introduction of the sutures. It is a procedure which should only be undertaken if the patient be in perfect health.

1. Freshening the edges is effected by removing a strip with a sharp knife from each side of the fissure.

2. To form the flaps, an incision is made on each side along the alveolar border of the jaw close to the gum, extending from the canine tooth in front to the last molar behind. With a periosteum elevator, bent at a right angle to its handle, introduced in this incision, the whole thickness of the soft structures, including the periosteum, is raised from the bone, from without inwards towards the cleft. Smith makes, with a scalpel, a small puncture down to the bone, midway between the teeth and the margin of the cleft, and opposite the middle point of this fissure; that is, midway between its anterior angle and the posterior margin of the hard palate. Through this puncture a slightly curved raspatory is introduced, between the periosteum and bone, and pushed onwards in the middle line until it appear in the cleft. This instrument is withdrawn, and a greater curved raspatory used to separate the periosteum from the bone by to and fro movements and judicious traction. When the posterior margin of the palate is reached, curved scissors are used to divide the attachment of the soft palate, which is drawn forward and the scissors passed behind it. The scissors are used with the blades closed, like a raspatory, to draw forward the soft parts at the junction of the hard and soft palates, and complete their separation from the bone. To accomplish detachment at the anterior angle of the fissure, a small rectangular knife can be used. Bleeding is arrested by the pressure of a sponge, and the same process is repeated on the other side. Tension is relieved by prolonging the small incisions backwards and forwards through the whole substance of the palate, by means of a probe-pointed knife. However the operation is performed, care must be taken not to injure the anterior or posterior extremities of the flap where the palatine arteries

are situated, as upon them depends the vitality of the parts. When the flaps are separated on each side, the margins of the fissure should meet easily in the middle line, and form a palate at a lower level than the fissure. The bleeding is very free, but ceases when the flaps are completely separated. If the palatine vessels be divided they bleed profusely, particularly the anterior, and this must be controlled by digital pressure and iced water. Smith writes: "In cases where the material for closing the cleft is scanty, a flap must be brought down from the septum nasi, and this can always be done when the septum, as is usually the case, is united with one of the maxillary bones. This flap should be traced out on the septum with a small rectangular knife, and brought down with a sharply curved raspatory."

3. The sutures, which are best of wire, should be introduced from before backwards, as in the operation of staphyloplasty, and twisted and cut short. They may be left in for a week or ten days, and removed by instalments. In bringing together the edges of the palate, the latter must be everted by a small double hook. The patient must be confined to a liquid diet, beef tea, milk, etc., and must not speak, but should use a slate to write what he wants. The cure of the cleft palate does not remove defective articulation, and must be followed by systematic instruction in speaking. Trélat advises the teaching should precede the operation.

In cases which have not united, either partially or wholly, after this operation, *Fergusson's Osteoplastic Method* is useful. In this operation holes are drilled through the margin of the palate for the sutures, then the lateral incisions are made down to the bone, midway between the cleft and the alveolar margin, holes being drilled with a curved bradawl in this line, to prevent splintering of bone; the latter is divided with a chisel. The flaps are brought together in the middle line and fastened with sutures, and the lateral openings may be plugged with lint for two days. If the vomer be attached to one edge of the cleft it is impossible to pass the stitches and bring the palate together at the lower level which is necessary to improve the speech. In such cases the soft tissues must be separated from the bone on that side as

before described, and, by a twist of the handle of the chisel, the palatal process of the maxilla is to be separated on either side. If the cleft cannot be closed by operation, an artificial palate should be worn. The advantage of first closing the soft palate is that the fissure in the hard palate often diminishes in size.

Torti-collis, or Wry Neck, may be congenital or acquired.

Causes.—Contraction of the museles, paralysis (rare), rheumatism, diseases of the cervical vertebræ. As a sequel of measles, scarlatina, and strumous inflammation of lymphatic glands. Loss of texture from sloughing after burns or wounds. A reflex spasmodic variety is occasionally met with. Central nervous irritation. Neuro-mimesis in hysterical girls. The muscles supplied by the spinal accessory nerve, namely the sterno-mastoid and trapezius, are mainly affected; but the platysma, scaleni, splenius, and levator anguli scapuli, may assist in producing the deformity.

Symptoms.—When the right sterno-mastoid is affected, the head is inclined to the right side, and slightly forwards. The right side of the neck is unduly concave, the left unnaturally convex. The chin is rotated outwards and approaches the left shoulder, whilst the right ear is brought near the sternal end of the clavicle. The right sterno-mastoid is narrow, hard, rigid, and shortened, and both origins may be so distinct that they appear like two separate muscles. The clavicle is often bent upwards by the excessive tension of the contracted muscle. The right side of the face will be less developed than the left, and the line of the eyes and mouth lower on the right side. The cervical vertebræ become curved with the convexity to the left, and rotated on their axes, and there is a compensatory curve in the opposite direction lower down. In long-standing cases some elevation of the right shoulder and scapula, with slight lateral curvature, is generally present. When paralytic in origin, the deformity can be easily reduced, but returns again on pressure being relaxed; when depending on contraction, the deformity cannot be reduced. In the spasmodic form, on attempting to replace the head, the muscles will often yield; unlike contraction, where the muscle becomes more tense. On bending the head towards the affected side in the

contracted form the muscle relaxes, but not in the spasmodic form.

Treatment.—When depending on contraction, section of the sterno-mastoid by tenotomy.

Operation.—An ordinary tenotome should be passed, from half an inch to one inch above the sternum, behind the tendon, with the flat side towards it, and then the edge is turned forwards and the muscle divided by cutting forwards. If the clavicular portion require division this should be done by a separate puncture. Some surgeons prefer passing the knife in front of the tendon, and cutting from before backwards, but this may endanger the vessels. The complete division is accompanied by a distinct snap. Any contracted portions of cervical fascia may be similarly divided, together with the other affected muscles. An anæsthetic is advisable, and the patient's head must be securely fixed by an assistant. The dangers are hæmorrhage, and the accidental entrance of air into a vein; both these casualties are treated by compression with a pad. The puncture is closed at once by a piece of lint soaked in styptic colloid. Afterwards a band of firm adhesive plaster, $1\frac{1}{2}$ inches broad, is applied round the forehead; to each extremity of this piece of plaster a strip of muslin is attached, which surrounds the head, and is fastened. To this bandage an elastic band is attached upon the side opposite the deformity, carried through the axilla, and returned to the place whence it commenced. This elastic band is made as short as is necessary to retain the head in its normal position and keep a constant traction. The head should be manipulated daily, and made to perform its proper movements. In acquired wry-neck, tenotomy is useful, and internally bromide of potassium, perchloride of mercury, iodide of potassium, opium, conium, and Indian hemp. The bowels must be kept freely acting. In obstinate cases recurring after tenotomy, exposure and excision of a portion of the spinal accessory nerve is of service, or stretching the nerve without division. The posterior belly of the digastric is the guide to the nerve, as the latter emerges from beneath this muscle to enter the sterno-mastoid. When depending on paralysis, the application of the continuous current to the paralysed muscle, followed by faradisation, is of

service, and hypodermic injections of strychnia over the paralysed muscle, with the elastic apparatus as described; tenotomy of course is of no use. If depending on disease of the cervical vertebræ, the treatment must be directed to this condition.

Dupuytren's Contraction of the Fingers consists in a flexed state of one or more of the fingers, due to thickening contraction and hypertrophy of the palmar fascia. The tendons of the flexors of the fingers are unaffected, being free in their sheaths; the joints also are healthy.

Causes.—It is much more common in men than in women, and particularly in those of a rheumatic or gouty diathesis; it is sometimes hereditary. Indulgence in alcohol seems to predispose to this affection. Exciting causes are slight mechanical injury, pressure from the use of a whip in driving, stick in walking, or a tool in trades which necessitate an instrument being pressed in the hollow of the palm. I have seen several cases in keelmen and bargees who have to row with heavy oars.

Symptoms.—The contraction commences insidiously, affecting mainly the ring and little fingers; less often the middle finger, index, and thumb are implicated. The patient feels a stiffness in the palm and is unable to straighten one or more of the fingers. On trying to extend the fingers a tense cord will be felt, extending from the palm to the anterior aspect of the contracted fingers, due to the indurated palmar fascia. The superjacent skin is usually healthy and not adherent. The deformity progresses painlessly and slowly, not reaching its extreme degree for several years. Both hands may be affected, but more frequently the right is alone the seat of disease.

Treatment.—In slight cases, friction, manipulations, and bandaging the fingers to a screw adjustment splint, or to a straight splint of wood, tin, etc., may be sufficient. In more severe cases, division of the contracted palmar fascia subcutaneously with a tenotome, by means of multiple incisions in the furrows of the contracted fascia, and then straightening the fingers gradually by bandaging them to a splint and using elastic bands. This part of the treatment should be done slowly, occupying three weeks to a month.

Web-Fingers.—This is a congenital deformity, and consists in two adjacent fingers being united by a web of skin, narrow at the base and broad above. It is apt to affect both hands symmetrically, and also sometimes the toes. Only one digital interspace may be thus filled up, and then it is usually situated between the index and middle fingers; but all the fingers may be webbed.

Treatment.—Simple division of the web is not sufficient, as the cut edges will unite. To obviate this a hole is made at the cleft, and a silver or leaden wire, or an india-rubber cord passed through, and retained like an ear-ring, until cicatrization have taken place, then the web is divided, and the angle having healed firmly, the lateral wounds will heal separately. M. Giraldés divides the web by a kind of enterotome, which is gradually tightened. When there is a distinct web the deformity can also be remedied by the following operation. A triangular flap with its apex towards the nails is made at the cleft on the dorsal surface, a similar one is then cut on the palmar surface. The web is divided above the apex of these flaps, which are united by sutures across the interdigital angle forming a bridge of skin. If there be no distinct web, Didot's operation should be performed. When the index and middle fingers are united a palmar incision is made along the middle line of the index finger as far as the junction extends. Two small straight incisions, beginning at the ends of the median incision, are carried inwards well on to the middle finger. The rectangular flap thus formed is dissected up as thickly as possible, and is thus left only connected with the palmar surface of the middle finger. Next a similar rectangular flap is dissected off the *dorsum* of the middle finger, on the completion of which the two fingers will be found separated. To cover the raw surfaces the first flap is wrapped round the middle finger and fastened with sutures on the *dorsum*, and the second flap brought forward over the index finger and united by stitches on the palmar surface.

Genu Valgum, Knock Knee, or In-Knee.—This is not a congenital deformity, but occurs in childhood and youth. The causes are improper or insufficient food, or defective assimilation. Prolonged

standing, particularly in growing lads from twelve to eighteen, as in shop and errand boys, smiths, printers, etc. It may be conjoined with rickets or talipes valgus. Both knees are generally implicated, but one more so than the other. The deformity commences with relaxation of the internal lateral ligament, which permits the external hamstring to draw the tibia outwards away from the internal condyle. The latter becomes large and prominent, the external condyle small and atrophied. The head of the tibia is large, and the patella thrown outwards. The structures on the outer side of the joint become contracted, namely the biceps, vastus externus, and external lateral ligament. The muscles and ligaments on the inner side are relaxed. To ascertain the amount of deformity the limb should be freely extended.

Treatment.—In slight cases, cod-liver oil, iron, fresh air, and a nourishing diet. Locally, the knee is strapped on padded wooden splints, a short one behind the knee to prevent flexion, and a long one reaching from the trochanter to the external malleolus, with daily frictions and manipulations. In more severe cases leg irons, extending from the pelvis to the bottom of the boot, fastened by a pelvic band and straps, a broad well-padded strap passing round the inner side of the knee. If the patient lie down during the day, except when taking the exercise necessary for his health, the cure will be accelerated. The apparatus must be worn for many months. If treatment be unpromising, the limbs may be forcibly straightened under an anæsthetic, and put up in lateral splints of plaster of Paris. In cases after the age of eight, when the bones are no longer soft, which appear incurable by mechanical means, osteotomy may be performed by entering a small sharp-pointed knife above the tubercle of the adductors on the inner condyle of the femur, in the middle of the inner surface of the thigh, and passing it obliquely downwards and outwards across the front of the condyles, the edge directed across the bone until the point reach the groove between the condyles inside the joint. The knife is withdrawn, cutting down to the bone on its way out, and enlarging the external incision. A narrow-pointed

saw is passed through the wound. If the patella be displaced outwards, the point of the saw can be felt in the intercondylar groove; if not, the patella must be lifted up and the point of the saw passed under it. The bone is then nearly sawn through with short careful strokes directly backwards, care being taken to cut the hard bone at the upper part of the section to the same extent as the soft bone. The saw is then withdrawn, and the condyle broken up and pushed upwards by straightening the tibia. The wound is then closed and the limb put up in plaster (Ogston). Reeves divides the bone with the chisel instead of a saw.

Macewen's Supra-Condylar Operation is better, and consists in dividing the shaft of the femur above the condyles with a saw or chisel, bringing the limb straight by force, and retaining it in its new position until the bone unite. The usual anæsthetic, aseptic, and bloodless precautions are employed. A scalpel is passed down to the internal surface of the femur, at the point of intersection of a line drawn transversely a finger's breadth above the top of the external condyle, and a longitudinal one drawn half an inch in front of the adductor magnus tendon, the limb being placed on its outer side on a pillow of moist sand; an incision is made an inch or more in length. A chisel is passed down to the bone, and then turned round so that its edge is perpendicular to the limb, and is made to penetrate the bone for a half or a third of its thickness. Then a finer chisel is applied, until the outer part of the bone will give way easily. If the tibia be much curved this can also be divided. The chisel or osteotome employed is a narrow wedge of steel, perfectly tempered and ground to a fine edge, with an octagonal handle in one piece with the blade.

Barwell first divides the external third of the femur just above the epiphysial line, then straightens the limb by rupturing the remainder of the partially divided bone. When the gap in the bone thus formed is filled up, the tibia is divided transversely and the fibula obliquely about one inch below the joint.

If the bones be not much affected, the tendon of the biceps can be divided. The patient is placed on his abdomen, and the limb slightly flexed, a tenotome is entered flatwise at the outer margin

of the tendon from an inch to an inch and a half above the knee, and passed on until it reach the opposite side, when the blade is directed against the tendon which is thus divided. The peroneal nerve may be severed, producing temporary paralysis. Any contracted fascia may be similarly divided.

Club Foot may be congenital or acquired. There are four simple forms: 1. Talipes equinus; 2. Talipes calcaneus; 3. Talipes varus; 4. Talipes valgus. In addition to these simple deformities, compound displacements occur from the presence of a secondary distortion, as talipes equino-varus, talipes equino-valgus, and talipes calcaneo-valgus.

The congenital cases depend on malposition of the limbs in utero, arrested development of the extremities; spasm from affection of the nervous centres, etc.

The acquired variety may be paralytic, spastic, or traumatic.

Talipes Equinus is so called from the position of the foot resembling the hoof of a horse. It is characterised by contraction of the muscles of the calf and elevation of the heel. The patient walks upon the toes, and the heel and posterior part of the foot do not touch the ground. Simple talipes equinus is the most common form of acquired talipes, but is rarely met with as a congenital affection. As an acquired affection, it may be the result of: 1. Spasmodic action of the muscles of the calf, as the result of reflex nervous irritation at the period of dentition, or from worms, etc.; 2. Paralysis of the flexors of the foot; 3. Of long-continued extension of the foot; 4. Contraction of cicatrices. The paralytic form is recognised from the fact that the foot can be easily replaced in its natural position, but when the restoring force is removed the deformity at once recurs; the heel is involuntarily drawn up higher when the patient walks than when he is at rest, from unchecked action of the muscles of the calf.

Treatment.—Division of the tendo Achillis subcutaneously.

Operation.—The patient being placed on his face, an assistant bends the foot on the leg, to throw the tendon into good relief. A tenotomy knife is then entered, an inch above the insertion of the tendon, into the os calcis, and close

to its inner side (with the flat of the blade towards the leg). The knife is passed under and well across, to the opposite side of the tendon, its edge turned towards the latter, when, partly by pressure and partly by a sawing movement, the tendon is divided from before backwards. A distinct snap will be felt, and the assistant must then let go the foot. The knife is then withdrawn with its surface flat as it entered. The surgeon's thumb should follow the knife, to prevent the entrance of air; a compress is applied, and a bandage. The wound will heal in from three days to a week, when a suitable apparatus is applied. Some surgeons prefer to divide the tendon from behind forwards, the knife being passed over the tendon, but this is liable to injure the posterior tibial artery.

Dressing after Tenotomy (Sayre).—After division of any of the tendons or fascia for the relief of the different distortions of the foot, and hermetically closing the wound in the manner already described, bring the foot *immediately* into its natural position, or as nearly so as can be done, and retain it there by the following dressing. Cut a thin board (as a cigar-box lid) into the shape of the sole of the foot, only a little longer, and square at the toes. Then take a piece of strong moleskin adhesive plaster *c* as wide as the board, and long enough to cover both sides of the same, and to reach from the toes to some inches above the knee. Apply the adhesive side of the plaster to the board, commencing in front at the under surface, passing over the upper surface round the back, and under the same to the front again; the remainder of the strip is subsequently to be applied to the anterior surface of the leg. The foot is then placed on the board, and secured at the heel by a strip of plaster passed over the ankle and around the heel part of the board, and in addition secured by a well-applied roller extending above the ankle. The foot is now brought into its natural position, and the strip of adhesive plaster *c* firmly drawn up and secured to the front of the leg by a roller; the superfluous extremity is to be reversed, bringing its adhesive surface outward, and the roller carried back over it will be more firmly fastened in position. If there be any tendency to valgus, another strip of

plaster *d* is made to nearly encircle it, and is drawn upon the inner side to correct the deviation, and securely fastened by a roller. If the tendency be to varus, the last strip of plaster is applied in the opposite direction.

Talipes Calcaneus is a rare variety of club foot; it may be congenital, but is usually acquired, and generally paralytic; occasionally it results from wounds severing the tendo Achillis, or from the cicatrices of burns.

Symptoms.—When the patient walks the toes are raised, all the weight being borne by the heel. The gastrocnemius and soleus are atrophied, and generally paralysed, whilst the muscles of the front of the leg are contracted. The heel is enlarged, and the sole unduly concave. The os calcis becomes vertical and the astragalus oblique, so that part of the articular surface may extrude from the joint backwards.

Treatment.—Subcutaneous division of the tendon of the tibialis anticus, extensor communis digitorum, extensor proprius pollicis, and the peroneus tertius, on the dorsum of the foot. A wooden splint is then applied to the sole of the foot, which is strapped down to it. Davy excises a portion of the tendo Achillis. Sayer advises a piece of thin board, as a cigar box, a little longer than the child's foot, covered with adhesive plaster and fastened to the sole of the foot, so that the board projects behind the heel. When fastened to the anterior part of the foot, the latter is brought into position and fixed by carrying a long piece of adhesive plaster attached to the posterior end of the board up along the back of the leg, and securing it with a roller bandage. When the child can walk, an ordinary shoe is worn, with a steel sole, having a spur projecting at the back, with an eyelet hole at its end. Two upright bars, jointed at the ankle, are attached to the sole of the shoe on either side. These bars end in a band which fastens round the upper part of the leg. At the posterior part of this band an artificial muscle (india-rubber band) is fixed, and attached below to the eyelet.

Barwell's Dressing is useful in all cases of club-foot. This consists in cutting from strong adhesive plaster a fan-shaped piece; in this are made several cuts converging to the apex of the piece for

its better adaptation to the part. The apex of the triangle is passed through a wire loop with a ring on the top, brought back on itself, and fastened by a few stitches. The plaster is firmly secured to the foot by other strips of plaster and a roller, in such a manner that the wire loop shall be at a point where we wish to imitate the insertion of the muscle, and shall draw evenly on other parts of the foot when traction is made. The artificial *origin* of the muscle is made as follows: Cut a strip of tin or zinc plate, in length about two-thirds of the tibia and in width one-quarter the circumference of the limb; this is shaped to fit the limb. About an inch from the upper end fasten an eye of wire. The tin is secured to the limb by cutting two strips of plaster long enough to encircle the leg, and in the middle of each making two slits just large enough to admit the tin and prevent any lateral motion; then cut a strip of plaster rather more than twice as long as the tin and a little wider, apply this smoothly to the side of the leg on which the traction is to be made, beginning as high as the tubercle of the tibia. Lay upon it the tin, placing the upper end level with that of the plaster. Secure this by passing the two strips before mentioned around the limb, then turn the vertical strip upwards upon the tin. A slit should be made in the plaster where it passes over the eye, in order that the latter may protrude. The roller should then be continued smoothly up the limb to the top of the tin. The plaster is again reversed and brought down over the bandage, another slit being made for the eye and the whole secured by a few turns of the roller. A small chain a few inches in length is then secured to the eye in the tin. A piece of ordinary india-rubber tubing a quarter of an inch in diameter, and two to six inches in length, with a hook fastened at each end, is fixed to the eye attached to the plaster on the foot and to the chain. The constant traction of the tubing is sufficient to overcome the strongest muscle. The only objection to this method is that the plaster is apt to irritate the skin; to obviate this, Sayre has contrived a modification of Scarpa's shoe, with a ball and socket joint, opposite the mesio-tarsal joint, and attaches the artificial muscles to the shoe, which is accurately secured to the deformed foot.

Talipes Varus is the most common form of club-foot. It may be congenital (most frequent) or acquired.

Causes.—Infantile paralysis, tonic spasms of the muscles from derangement of the nerve centres or nerves, and traumatic causes.

Pathology.—The os calcis is drawn upwards and backwards, so that its hinder surface is brought nearer to the back of the leg by the action of the gastrocnemius and soleus. The surfaces of the astragalus which articulate with the tibia are projected forwards and exposed in the dorsum of the foot, and the external malleolus is thrown backwards. The scaphoid, cuboid, and cuneiform bones are drawn inwards and upwards, so that the inner border of the scaphoid touches the internal malleolus, whilst the cuboid is only in contact with the os calcis at its plantar surface, being separated above by an interval. A longitudinal and oblique furrow is formed in the sole of the foot in the congenital variety. The bones are somewhat atrophied in old-standing cases, otherwise they are not changed. The posterior ligament of the ankle, the deltoid, calcaneo-scaphoid, superficial and deep plantar ligaments, the fascia and integuments are shortened on the posterior and internal aspects of the foot, and the corresponding structures lengthened on the convex side. The tendons are altered in direction; that of the tibialis anticus is situated over the internal malleolus instead of in front of it, and the tibialis posticus is moved forwards resting midway between the anterior and posterior borders of the leg, and on leaving the malleolus passes in a direct line to the scaphoid, being thus situated more deeply. The muscles of the foot, leg, and thigh are atrophied.

Symptoms.—In slight cases the foot forms with the leg a larger angle than a right angle, and the deformity can be easily reduced by pressure with the surgeon's hand. In more severe cases it cannot be reduced by pressure. In the worst cases the foot makes an acute angle with the leg. There are elevation of the heel, adduction of the toes, and the foot is twisted, or inverted, so that the patient treads on the outer margin, and in severe cases on the dorsum, whilst the sole of the foot is vertical instead of horizontal. The inner side of the foot is much shortened, the great toe being

approximated to the heel. The skin over the outer side of the foot is much thickened, rough, and horny if the patient have walked.

Treatment.—Sayre advises in all cases of talipes: 1. Restore the foot to its natural position; 2. Assist nutrition by all means within reach, as heat, friction, motion, galvanism, injection of strychnine, etc. In congenital club-foot the treatment should commence at birth. In slight cases rubbings and manipulation, together with bandaging the foot to a padded splint bent at a right angle, having a movable joint and a lateral portion attached to the foot-piece to press against the inner border. The extension should be very gradual, and the splint removed daily to improve the position. Sayre writes: "A large majority of congenital deformities, if taken *immediately* after birth, can be easily restored to, and retained in, their normal position by adhesive plaster. This can be applied in the following manner: Cut a piece of strong adhesive plaster (Maw's moleskin is the best) from two to four inches in width, and of sufficient length to go nearly around the foot, and to extend some inches upon the thigh. Commence on the dorsum of the foot with one extremity of the plaster at a slightly oblique angle, and wind it around the sole smoothly in the direction in which the foot is to be drawn; then with the hand draw the foot as nearly as possible into the natural position, and carry the plaster up the leg and secure it by a well adjusted bandage as far as the head of the fibula; as the plaster was cut longer than the leg, the end can then be reversed with the plaster outside, over which the roller is again carried down the limb, and the plaster will thus prevent it from slipping. Care must be taken *not* to let the plaster completely encircle the foot, and a few nicks cut in the edge *nearest* the ankle may be necessary to prevent strangulation of the circulation, when the foot becomes flexed." A second strip of plaster may be applied in a similar manner outside the bandage if more traction be required. If there be not much improvement, and in all severe cases, tenotomy must be performed: Sayre lays down the following rule to determine the necessity for this operation: "Place the part contracted as nearly as possible in its normal position, by means of manual

tension gradually applied, and then carefully retain it in this position; while the parts are placed upon the stretch, make additional point pressure with the end of the finger or thumb upon the parts thus rendered tense; and if such additional pressure produce *reflex contractions*, that tendon, fascia, or muscle must be divided, and the *point* at which the reflex spasm is excited is the point *where* the operation should be performed. If, on the contrary, while the parts are brought in their normal position by means of manual force gradually applied, the additional point pressure do *not* produce reflex contractions, the deformity can be permanently overcome by means of constant elastic tension, and the more you cut the greater will be the amount of damage done." In congenital varus if necessary the operation should be performed within the first few months after birth; after the operation a pasteboard or metal splint, previously fitted to the foot, should be applied until the wound have healed. Subsequently, Little's or Scarpa's shoe, or Aveling's talivert, or a properly-fitting wooden or metal splint must be applied. The treatment must continue from a few weeks to months. The tendons which may require division are the tibialis anticus and posticus, the flexor longus digitorum, and sometimes the extensor and abductor pollicis. In addition, the tendo Achillis, and sometimes the plantar ligaments require division. Little recommends that the tendo Achillis should not be divided until the inversion be cured.

Division of the Tendons of the Tibialis Posticus.—In performing this operation the danger to be avoided is wounding the posterior tibial artery, which is in close proximity to the nerve. The patient should be placed on his back, with the limb to be operated on rotated outwards, so that the inner surface looks upwards. An assistant holds the knee with one hand and the foot with the other. If the left foot be operated on, the surgeon sits in front and grasps the foot with his left hand, feeling for the posterior tibial tendon. If the tendon cannot be felt, the inner edge of the tibia should be recognised, a finger's breadth above the inner malleolus, and if this cannot be recognised, a line on the inner side of the leg, exactly midway between the anterior and posterior borders of the leg, is the guide to the tendon. A

tenotomy knife is passed through the skin, half an inch to an inch above the internal malleolus, for a quarter or half an inch directly downwards perpendicularly to the surface, and is withdrawn, having divided the skin, superficial fascia, deep fascia, and the sheath of the tendon. A probe-pointed knife is then inserted in the wound, so as to get well between the bone and the tendon; the edge is then turned towards the tendon, and a slight cutting movement severs it, while an assistant abducts and depresses the inner border of the foot. When the right tibialis is divided, the surgeon stands on the left side with his back to the patient's face. If the posterior tibial artery be wounded, it should be cut completely across, and a pad and bandage applied. In adults the tendon can also be divided on the side of the foot behind its insertion into the scaphoid bone, half an inch below and in front of the tip of the malleolus. The knife is passed from above downwards, under the upper border of the tendon, which is divided from within outwards, or the knife may be passed between the skin and tendon, and this may be divided by cutting down to the bone. The foot must be forcibly everted by an assistant.

Talipes Valgus, Flat Foot, or Splay Foot.—The arch of the foot is diminished or obliterated, the patient treads mainly on the inner border of the foot, the sole of which is somewhat everted. The disease is due to weakening and elongation of the plantar muscles and ligaments, especially the tendon of the tibialis posterior, calcaneo-scaphoid ligament, and long plantar ligament. The peronei after a time become contracted and permanently shortened, causing eversion of the toes. Pressure with the thumb over the borders of the articular surfaces of the cuneiform and scaphoid bones, when in their abnormal position, produces extreme pain, but when the foot is rotated inwards and the arch raised, the foot is able to support the weight of the body without pain. Pain and difficulty are also produced in walking. After a varying interval the foot may become convex inferiorly, the front being drawn up by the anterior tibial muscle, and the extensor of the toes and the heel by the muscles of the calf. This, which is termed spurious valgus, occurs in young adults from long-continued standing, carrying

heavy weights, and sudden exertion as in athletics; in those with a rickety tendency; other causes are rheumatism, sprains, or other injury of the plantar ligaments. Both feet are commonly affected, but not equally so. In addition to this form there is a true valgus which is uncommon, and arises from congenital contraction of the peronei; an acquired valgus from non-congenital contraction of the peronei; and a paralytic form, due to contraction of the peronei subsequent to paralysis of the tibialis anticus. The true congenital valgus is the exact opposite of varus, and is not common; there are partial flexion of the ankle and abduction and eversion of the foot, so that the external edge is removed from the ground. The malleolar face of the astragalus is turned downwards, and does not touch the malleolus; the scaphoid and os calcis follow the astragalus, and with the internal malleolus touch the ground by their internal surfaces; the external borders of the cuboid, fifth metatarsal bone, and os calcis look directly upwards. The peronei and extensor longus are contracted, and the tendo Achillis tense and moved outwards.

Treatment.—In flat foot: fresh air, tonics, friction, manipulations, and attention to the general health, with rest to the feet, by the patient assuming the recumbent position for a certain time every day. Laced boots supported at the sides. Elastic, horsehair, india-rubber, steel arch, or felt pad beneath the inner margin of the foot to support the arch; or the heel of the boot may be carried forwards on the inner side. In more difficult cases an apparatus similar to that for varus, but reversed. In bad cases, under an anæsthetic the foot must be wrenched into its proper position and fixed in a position of extreme inversion in a splint of plaster of Paris; this process may be repeated in a month's time. If necessary, the peroneal tendons and the extensor longus digitorum should be divided subcutaneously, the former at the posterior face of the lower end of the fibula, about half an inch above the external malleolus, or on the side of the foot below and in front of the tip of the outer malleolus. When dependent on rickets, tenotomy is rarely required. In paralytic cases the tendo Achillis may have to be divided, but *not* the peronei.

Talipes Equino-Varus consists in elevation of the heel and inversion of the toes, and is usually acquired; it may be paralytic or spastic.

Treatment.—Subcutaneous division of tendons and mechanical apparatus.

Davy's Operation in old-standing cases not amenable to treatment is thus performed. Chloroform and Esmarch's bandage are used. He cuts directly down on the cuboid, from the outer side of the foot, through the indurated skin and bursa, and makes the cut T-shaped by extending it over the dorsum. Having definitely exposed the upper and outer surface of the cuboid, the bone forceps are screwed into the cancellous structure of this bone, and expanded until the blades give a firm leverage. Then he carefully divides the ligaments round the bone and wrenches it out; it is necessary to avoid injury to the tendon of the peroneus longus beneath, by keeping close to the bone. The wound is closed by sutures, and an internal foot and leg splint applied with a gum and chalk bandage.

Davies Colley's Operation in severe forms of this affection consists in the removal of a wedge-shaped piece of tarsus, by means of an incision three inches in length along the outer border of the foot, extending from the middle of the calcis to the middle of the fifth metatarsal bone. A second incision is made across the dorsum of the foot from the centre of the first, two inches in length.

Talipes Equino-Valgus as a congenital affection is rare, but may be met with in the acquired form as the result of paralysis of the anterior tibial. The heel is elevated and the foot everted.

Treatment.—Tenotomy and mechanical applications.

Talipes Calcaneo-Valgus.—The front of the foot is raised and abducted through the contraction of the peronei and extensor longus digitorum, combined with contraction of the anterior tibial and extensor proprius pollicis. As a congenital affection it is rare, but it may be acquired from paralysis of the gastrocnemius.

Treatment.—Tenotomy and mechanical applications.

Bunion is an enlarged and thickened bursa, situated over the inner side of the metatarso-phalangeal joint of the great toe.

Causes.—Pressure of ill-shaped or badly-fitting boots, which force the two inner toes outwards, under, or over the other toes. From pressure and irritation the head of the metatarsal bone enlarges, and is often the seat of small, bony outgrowths. The cartilage is destroyed, the subjacent bone sclerosed, the ligaments relaxed on one side and shortened on the other, and the tendons displaced outwards.

Complications.—Inflammation, suppuration, ulceration. The ulcer is slow in healing, and apt to become the starting point of cellulitis, erysipelas, or gangrene; it may also open into the joint, leading to its destruction.

Treatment.—Proper boots, with a straight inside border. A strip of plaster may be attached to the phalanx, carried along the inner side of the foot, round the heel, and along the outer side, and fixed by a bandage. A piece of cotton wool is placed between the first and second toes. Sayre recommends the use of a glove of linen or buckskin fitted over the phalanges. A piece of webbing is attached to this, and fastened to a strip of plaster, applied as above. In difficult cases, a metal sole-plate, with a spring to draw the toe inwards. If unsuccessful, tenotomy under aseptic precautions, an anæsthetic being used, and then forcible reduction of the toe; or osteotomy may be performed. If the case be not amenable to this treatment, amputate by the oval method. The bursitis is treated as that of other bursæ: make an early incision if there be suppuration, and treat with carbolic oil or iodoform, and afterwards ung. resinæ, or hyd. biniodid. gr. x, to vaseline ʒj. In old patients give opium internally.

Cicatricial Deformities result from the contraction of scars, particularly those of burns. The cicatrices are divided into: 1. Broad, parchment-like, as met with in front of the neck; 2. Narrow or bridle, as in the front of the arm; 3. Adhesion of two contiguous surfaces; 4. Depressed cicatrices, due to deep loss of substance, the skin being attached to the bone.

Treatment.—1. Extension by elastic bands, weights, etc. 2. Compression by plaster and elastic bandages. 3. Operation by subcutaneous division; by incision, using one cut or several. 4. Division, and after the deformity is relieved,

bringing the edges together at right angles to the wound. 5. Excision. 6. Freeing the cicatrix by division of the skin above and below, and subcutaneous division. 7. Plastic operations, the gap being filled up by a flap of skin.

Meningocele is a congenital hernia of the membranes of the brain through some part of the cranial osseous wall. The sac is formed by the dura-mater and arachnoid covered by the skin, but as a rare event the latter may be absent. The sac is filled and distended with cerebro-spinal fluid. If brain substance be also present the term *encephalocele* is used, and when this is conjoined with hydrocephalus, *hydrencephalocele*. The tumour is due to an arrest of development in one or more of the bones forming the skull. In size there is great variation, from a marble to a cocoa-nut. The most

common situation is the middle line of the occiput.

Symptoms.—A tumour, with the skin over it of a blue or pink colour, and tightly stretched. If fluid be present, the tumour is translucent. When the disease is small, the swelling can be reduced, but such reduction is apt to produce cerebral disturbance. In an *encephalocele* pulsation is present synchronous with that in the radial artery. The bony ring through which the tumour protrudes can be often felt. Other deformities are often associated, as cleft palate, talipes, or spina bifida.

Prognosis is very unfavourable, most cases soon terminating in death.

Treatment.—As a rule no interference is advisable. If the tumour be an uncomplicated *meningocele* of medium size with a peduncle, Morton's fluid may be injected as in spina bifida.

SECTION XII.

CHAPTER XLII.

ANÆSTHESIA AND AMPUTATIONS.

Anæsthesia is used to prevent pain, produce relaxation of the muscles, and assist in diagnosis. The chief anæsthetics employed are: 1. Chloroform; 2. A. C. E. or 1, 2, 3 mixture (consisting of alcohol 1 part, chloroform 2 parts, ether 3 parts); 3. Ether; 4. Bichloride of methylene; 5. Nitrous oxide.

Preparation of the Patient.—1. The bowels if confined should be emptied by a purgative or enema. 2. No food is to be taken for four hours prior to the operation, or vomiting is likely to occur. 3. The patient is to be in the recumbent position, and the clothes loose about the neck, chest, and abdomen; the head must only be slightly elevated. 4. Artificial teeth must be removed. 5. The bladder should be previously emptied, or involuntary micturition may happen. 6. *Never administer an anæsthetic unless a third person be present, as the patient on recovering consciousness will sometimes falsely and without the slightest founda-*

tion charge a medical man with rape or indecent assault, etc.

Chloroform. Advantages.—1. Will procure anæsthesia when used in small quantities. 2. Is not disagreeable to inhale. 3. Requires no special apparatus. 4. Does not irritate the air passages. 5. Its vapour is not inflammable and not readily combustible.

Disadvantages.—1. Is a depressant to the heart, and may cause a fatal syncope. 2. Is apt to produce vomiting.

Cases in which Chloroform is preferable.—1. Children. 2. Operations on the mouth or nose. 3. Operations on the eye. 4. In cases of fracture. 5. Where there is disease of the respiratory organs, as bronchitis, etc. 6. In Bright's disease. Children take chloroform well, and as it requires no special apparatus, it excites no fear. In operations about the face ether is so inflammable that its use is prohibited. In operations about the mouth chloroform can be adminis-

tered through a leaden tube inserted into the nostril. In disease of the respiratory organs ether cannot be used owing to its irritant effects.

Physiological Action of Chloroform.—Ringer thus describes the action of chloroform. "At first there is a sensation of warmth at the pit of the stomach, spreading to the extremities, and accompanied by some excitement. Then some or all of the following symptoms set in: Noises in the ear, lights before the eyes, great weight and oppression of the chest, great beating of the heart, throbbing in the large vessels, and a choking sensation. These symptoms betoken no danger and need excite no apprehension. At the very commencement of the administration some cough is not unfrequently excited, or even a passing spasm of the glottis—sure signs that the vapour is administered in too concentrated a form, and that more air must be mixed with it. At this early stage of the proceedings women, by becoming hysterical, may give some trouble and alarm. They laugh, sob, or cry, their breathing is often irregular and hurried—a condition which frightens the friends and inexperienced chloroformists; but this state is to be accepted as an indication to continue the administration, not to withhold it; for as the patient passes more deeply under the power of the anæsthetic, this condition soon subsides.

The Pulse, at first quick, and it may be weak, if not due to the patient's illness, is the effect of nervousness and anxiety, and as soon, therefore, as unconsciousness sets in, the pulse falls in frequency and gains in force.

A few seconds from the commencement of the administration all discomfort ceases; the patient becomes quiet and breathes calmly. The consciousness is now more or less affected; questions are still heard, but are slowly answered, and not to the purpose.

Period of Excitement.—All knowledge of the external world soon becomes lost, and is followed by a period of excitement. Various incoherent ideas occupy the mind. Some struggle, attempt to get up, and are often much irritated when they are restrained. The state of complete unconsciousness required for capital operations is now fast approaching. Violent tonic contraction of the muscles of the body often occurs before complete uncon-

sciousness and perfect muscular relaxation sets in. The extremities become rigid, the muscles of the chest are firmly fixed, and the respiration thus becoming impeded, causes, in combination with the general violent muscular contraction, duskiness or lividity. The eyes are injected and prominent, the lips blue, the jugulars stand out like large black cords, the mouth is clenched, and a profuse perspiration breaks out on the body, especially about the face. In a few seconds all these symptoms pass away. They may be accepted as a sure indication of the immediate approach of utter insensibility and complete flaccidity of the muscles, and as a warning that the administration must be conducted with increased caution, or the patient will suddenly pass into a state of danger, with noisy, stertorous, quick, shallow breathing, and quick, weak pulse. These violent contortions, which greatly distort the face and frighten the patient's friends, rarely occur in women or children, or in men weakened by exhausting illness." Adults struggle most, men more than women, and persons habituated to indulgence in alcohol are always troublesome. This condition is least likely to appear when chloroform is inhaled slowly and in small quantities.

State of Complete Relaxation and Insensibility.—"As these movements cease, the muscles become more flaccid, and the stage of perfect insensibility is reached. Reflex action is lost, *the conjunctivæ can be touched without producing winking. The limbs, when raised and let go, fall heavily.* The breathing is calm, but a little superficial; the pulse is not much altered, but may be a little more compressible. The face is moist with perspiration. The pupil is much contracted. This condition may be maintained with due precaution for a considerable time, but if now the chloroform be continued in undiminished quantity, the breathing becomes noisy and stertorous; the pupil gently dilates; the pulse loses its strength; the breathing becomes gradually more and more shallow, and less and less frequent, until both pulse and respiration stop. On the other hand, it appears that sometimes, without warning, while the pulse is beating well and the breathing is deep and quiet, the heart suddenly stops, and respiration immediately ceases. This form of death

arises probably from cardiac syncope, while the other form of death is probably due to gradual paralysis of the respiratory muscles. With care, chloroform insensibility can be maintained for hours and even days."

Mode of Administration.—For adults I prefer Junker's inhaler, consisting of a graduated bottle capable of holding about 2 ozs., closed by an air-tight fitting cap, through which two tubes pass; one, connected to a hand bellows, proceeds to the bottom of the bottle, the other is attached by india-rubber tubing to a vulcanite face-piece, and commences at the top of the bottle. In using this apparatus six to eight drachms of the anæsthetic is poured into the bottle, which is hooked to the chloroformist's coat. The face-piece is applied somewhat firmly over the patient's face, and the bellows gently pressed at each inspiration. The quantity of the vapour is regulated by the frequency and amount of pressure on the bellows. A leaden tube can be used instead of a face-piece in operations on the mouth and nose. Administration of the vapour per rectum can be employed with this apparatus, but such a method possesses no conceivable advantage over the usual plan of inhalation. For children nothing is better than a piece of lint, about twelve by six inches, forming a square of about six inches, on which chloroform is sprinkled from a small drop bottle. Commence with a few drops, and gradually add more.

Danger-Signals.—1. *Pulse.* If it become quick, weak, and irregular.—2. *Breathing.* If shallow and declining in frequency.—3. *Lividity* and extreme pallor of the face.—4. *Dilatation* of the pupil.

It is to be remembered that operations on the rectum and vagina, even when the patient is quite insensible, generally cause noisy catching breathing, resembling stertorous breathing, but only occurring when the vagina and rectum are manipulated.

Restoration of Animation.—Seize the tongue with forceps and draw it forwards, commence artificial respiration; total inversion of the body, the patient being suspended by the legs, head downwards; subcutaneous injection of ether; fresh air; faradisin, one pole being applied to the right side of the neck, above the clavicle and over the posterior border of

the sterno-mastoid, and the other to the epigastrium, or one pole in the mouth and the other in the rectum; enema of brandy; nitrite of amyl or ammonia to the nostril; flagellation with the corner of a wet towel; elevation of the limbs, and compression of the abdominal aorta.

Ether. Advantages.—1. It acts as a cardiac stimulant. 2. Vomiting is less apt to occur, and when present is not so prolonged as after chloroform.

Disadvantages.—1. Is disagreeable to inhale. 2. Requires a special apparatus. 3. Is very irritating to the air passages. 4. Is very inflammable.

Cases in which Ether is to be employed.—In all those cases requiring an operation in which chloroform is not preferable, as before stated.

Physiological Action of Ether is similar to that of chloroform, with the important difference that the pulsation of the heart increases in force, and death when it occurs is the result of paralysis of the muscles of respiration and of obstruction of the air passages, and not from cardiac syncope.

Mode of Administration.—The best mode of giving ether is by Clover's or Ormsby's ether inhaler. Some administrators commence with nitrous oxide or chloroform until the patient be sufficiently unconscious as not to be sensitive to the discomfort of ether. A rough-and-ready way to etherise the patient is to take three or four thicknesses of stout brown paper, or ten of newspaper, measuring twelve by fifteen inches; this is to be covered with a thick towel well pinned on, and rolled into the form of a cone a foot long and five inches in diameter, which is fastened with long pins. A hole is left in the apex of the cone large enough to admit the little finger, and the corners at the base should be turned back. If the towel be thick it will hold all the ether that is required. The base of the cone is pressed close to the face, so that all the air has to enter by the apex. Both Clover's and Ormsby's inhalers make the respirations pass to and from an india-rubber bag over the ether. Ormsby's contains a sponge which is saturated with ether (about 1 oz.), and has a valve to regulate the admission of air.

Clover's Ether Inhaler produces anæsthesia partly by the diminution of oxygen

respired and partly by ether vapour. The inhaler consists of: 1. A face-piece and indicator; 2. A bag. When the indicator points at 0, the respired air passes to and from the bag without entering the ether chamber; when the indicator stands at F, all air on expiration and inspiration passes through the ether chamber, carrying off a large amount of this vapour. When the indicator marks 2, half the respired air only passes through the ether chamber. One-and-a-half ounces of ether are poured into the ether chamber. The indicator is placed at 0, and the face-piece raised during inspiration, but firmly pressed down during expiration, until the bag be somewhat distended, when the face-piece need no longer be raised. Gradually during every second or third respiration the indicator is moved, so that more and more air passes through the ether chamber. Should the bag become empty, the apparatus is raised for one inspiration, and then pressed down during expiration. With regard to the admission of pure air, as this cannot find entrance through the apparatus, the latter is removed, and an inspiration of air allowed every half-minute, and after anæsthesia is produced every three or four respirations. Complete anæsthesia is shown by deep snoring.

Danger-Signals.—Watch the respiration; if the respiratory muscles cease to act employ artificial respiration and stimulants. Should the air passages be obstructed by vomited matter, etc., raise the hips and lower the shoulders and the head, then perform tracheotomy if necessary. When the obstruction is due to the tongue falling back, a piece of wood should be inserted between the patient's teeth and the tongue drawn forward forcibly by forceps.

Bichloride of Methylene is by some considered safer than chloroform, and acts in the same way. It is a colourless fluid, with an odour like chloroform. The vapour is inflammable. It has no advantages over chloroform, and is less safe than ether. It can be administered with Junker's inhaler.

Nitrous Oxide is the safest anæsthetic, but can only be used for short operations, as extracting a tooth, incising an abscess, etc.

Physiological Action agrees closely with that of oxygen, first producing cardiac

stimulation and then asphyxia. Lividity of the face soon occurs, but is not a sign of insensibility. The eye is fixed, and if the conjunctiva be touched the eyelids contract feebly or not at all. Convulsive twitchings of the hand and oscillation of the eyeball next occur, and respiration becomes slower and stertorous.

Mode of Administration.—The gas is sold in a liquid form in iron bottles by Messrs. Coxeter, and by Barth & Co. The contents of the bottle are easily measured by weighing. A gallon weighs about $\frac{3}{10}$ ths of an ounce. Fifty gallons weigh 15 ozs., which is enough for ten administrations. *All air must be excluded*, the gas being inhaled from an elastic bag capable of holding eight to ten gallons, which communicates with an iron bottle by an india-rubber tube. The mouthpiece is connected with the bag by another tube, and has two valves arranged so as to prevent the entrance of atmospheric air, but allow the passage of expired air. Unconsciousness seldom lasts more than a minute or two. No vomiting is produced, and there is no unpleasantness in the smell or taste of the gas.

Danger-Signals.—1. Dilatation of the pupil. 2. Intermission of breathing.

To restore Animation.—Free admission of air and artificial respiration. Faintness is best treated by the recumbent posture and ammonia or nitrite of amyl.

A.C.E. Mixture is probably the safest anæsthetic next to nitrous oxide. It can be used in the same manner as chloroform, and should be freshly prepared previous to inhalation. It is merely a mechanical mixture.

Treatment after Anæsthesia.—Keep the patient in the recumbent position. If possible do not rouse him, but allow him to pass from the state of anæsthesia into natural sleep. A subcutaneous injection of morphia and atropine is often of service after painful operations. To stop vomiting, ice to suck, and iced or frozen milk, or milk and soda water; but if it still be obstinate, try warm water as a drink. To remove the taste of ether from the mouth, rinse it out with warm water in which a teaspoonful of eau-de-cologne is mixed.

Local Anæsthesia may be obtained by the action of cold, as by a freezing mixture (ice and salt), or by the ether

spray. Carbolic acid is a convenient means of producing local anæsthesia. A cloth thoroughly wet with a 3 per cent. solution of the acid should be applied to the skin for fifteen minutes, and then pure acid brushed along the line of incision. Muriate of cocaine in solution will produce anæsthesia of mucous surfaces, two or three applications being made at intervals of five minutes. For the removal of foreign bodies from the eye a 2 per cent. solution; for operations on the cornea a 4 per cent. solution; for other mucous membranes a 10 or 20 per cent. solution.

Amputations.

Methods. — (α) Circular. (β) Oval. (γ) Flap.

(α) *The Circular* is in general use on the Continent, and is performed in three steps: 1. Division of the skin and separation; 2. Division of the muscles; 3. Division of the bone. The rule is, make the section of the skin in the upper limb three fingers' breadth below the place where the bone is to be sawn; and in the lower limb four fingers' breadth.

First Step.—An assistant draws the skin towards the patient's trunk. The surgeon passes his hand beneath and behind the limb, and, turning the point of the knife towards his own face, he places the edge of the knife on the upper surface of the limb, as far forwards as he can reach, and sweeps it entirely round the limb, describing a circle and dividing the skin and subcutaneous cellular tissue. These structures are next separated from the deep fascia, and turned upwards over the limb with the raw surface outwards, by means of a few touches of the knife, until the place of section of the bone be reached.

Second Step.—The fascia and muscles are cut through with a similar circular sweep down to the bone.

Third Step.—The soft parts are drawn up with a retractor, the periosteum is divided circularly, and the heel of the saw placed upon the bone, steadied by the thumb nail of the left hand, and drawn from heel to point to make a groove, and then directed to and fro from point to heel, with slight pressure, until the bone be cut.

(β) *The Oval Method* will be described under the head of particular amputations.

(γ) *Flap Method.*—There are various varieties of this operation. 1. Double flaps. 2. Long anterior flap. 3. Long rectangular (Teale's). 4. Modified flap. 5. Posterior flap.

1. *Double Flap.*—The two flaps may be made by transfixion, or by cutting from without inwards. Where the parts are thick and muscular transfixion is preferable. The flap farthest from the vessels is first made. The flaps may be antero-posterior or lateral.

2. *Long Anterior Flap.*—A long anterior flap is made of skin and cellular tissue, without any posterior flap, forming a flat-faced stump with a bonnet to fall over it. This is used in Carden's amputation of the knee, etc.

3. *Long Rectangular* (Teale's).—This is performed by a long and short rectangular flap. The long flap is cut so that the large blood-vessels and nerves will not be included, but left for the short one; it is therefore anterior in the leg, posterior in the forearm. The length and breadth is equal to half the circumference of the limb at the place where the bone is to be divided. The short flap is one-fourth the length of the long one. The flaps are marked out with ink, and raised from without inwards, including the muscles; and the bone is sawed at the angle of union. After the vessels are tied the long flap is bent on itself and united to the short flap. The objection to this mode is that in many cases, from the length of the long flap, the bone must be sawn higher than it would otherwise have to be, and as it is an important rule not to remove a greater portion of the body than is necessary, owing to the mortality increasing with every inch of bone removed, this operation is only useful in certain cases.

4. *Modified Flap.*—This is one of the most satisfactory flap operations. The flaps include only the skin and cellular tissue. The muscles are divided at the base of the flaps, retracted, and the bone cleaned and sawn higher up.

5. *The Posterior Flap* is chiefly used in Syme's amputation at the ankle, where it will be found described.

Esmarch's Bloodless Method.—An elastic bandage is applied to the limb from the fingers or toes upwards to a suitable spot. Where the bandage terminates, an elastic tube or cord is applied by two or three turns round the limb. The bandage is

then removed and the limb is seen quite white and bloodless. The elastic tourniquet is fastened by hook and eye, tapes, or a wooden clip. The only objection to this valuable procedure is that after removal of the tourniquet copious oozing from the wound is apt to occur; this is best checked by pressure, elevation, and the application of hot water.

Particular Amputations.

The Fingers.—The distal phalanx rarely requires amputation, for in cases of necrosis following whitlow it is better to excise the bone by a linear incision through the pulp of the finger, and in instances of injury the removal of the crushed piece of bone will leave a serviceable finger. If necessary, the phalanx can be easily amputated at the articulation, the only difficulty being to hit the joint; the best guide is the palmar fold, which is a line posterior to the joint. The joint is flexed, and the adjacent fingers held apart by an assistant, with a loop of bandage tied round each. The surgeon with a narrow-bladed knife cuts into the joint on the dorsum, and divides the lateral ligaments; then the edge of the knife is turned forwards, and insinuated behind the base of the phalanx, a flap being cut from the pulp of the finger, whilst the knife is kept close to the bone. Or the palmar flap may be first completed by transfixion, and then the joint cut across whilst the finger is extended.

Amputation through the Joint between the Middle and Metacarpal Phalanges can be performed in the same manner, but except in the case of the index finger, is inadvisable, because no flexor tendon is attached to the metacarpal phalanx; thus removal of the whole finger is preferable.

Amputation in the Continuity of a Phalanx may be performed by a circular incision with a longitudinal incision one-third of an inch long on each side, or a palmar flap made by transfixion may be employed.

Amputation at the Metacarpo-Phalangeal Articulation.—This can be done by the circular or oval method, or by lateral flaps. If performed by the circular method, the incision through the skin must be at the level of the web, and the skin raised from the phalanx until the joint be reached.

By the Oval Method.—Care must be taken to leave sufficient skin to cover the

round head of the metacarpal bone, forming the knuckle. The articulation can be felt by passing the thumb and finger along the sides of the condemned digit, and at the same time drawing this away. An incision is made commencing slightly posterior to the joint, on the dorsal surface, carried along somewhat obliquely until the level of the web be reached, then across the groove on the palmar surface, and finally obliquely backwards to rejoin the incision. The flap is raised, the extensor tendon divided, the joint traversed, and the amputation completed by dividing the flexor tendons. Two arteries will require ligatures. The removal of the head of the metacarpal bone by bone forceps adds to the appearance of the hand, but weakens its strength; in the case of the index and little fingers, this if necessary should be done obliquely.

By Lateral Flaps.—The incision is commenced over the dorsum, quarter of an inch posterior to the joint, and carried along the centre of the phalanx to the junction of the web; then along the palmar groove to a corresponding point on the palmar face, and backwards to a quarter of an inch behind the flexor fold. A similar incision is made on the other side. The flaps are dissected off and the joint opened as before; or after cutting one flap on the side corresponding to the right hand of the operator, the lateral ligament may be divided, the joint opened, and the other flap cut from within outwards.

After-treatment.—The wound is closed with sutures, and covered with water dressing, a splint applied to the hand, and the ends of the fingers fastened together by a bandage.

Amputation of the Metacarpal Bone can be effected by using one of the previous methods with the addition of a single dorsal incision, having its point of origin corresponding to the place where the bone has to be divided. The soft parts must be separated from the bone, the knife being held parallel; next the bone is divided, and the point of the knife passed in front of the bone, taking care not to injure the palm, and the soft parts separated by cutting forwards. Elevation of the divided bone with necrosis or lion forceps is a great assistance. The bone should always be divided with the bone forceps, and not

disarticulated at the wrist, or the large synovial sac will be opened.

Amputation of the Fifth Metacarpal Bone.—This bone can be disarticulated, as its synovial sac does not communicate with the common sac. It may be removed by oval incision or by lateral flaps.

By Oval Incision.—Commence the incision on the inner side of the dorsum just above the base of the bone, and carry it along as far as the junction with the web, then across the palmar surface, *not* in the palmar groove, but anterior to this on a level with the web, then back to its commencement. Finish the operation as in amputating the other metacarpal bones, with the exception of disarticulating the bone.

By Lateral Flaps.—Raise the soft parts on the inner side of the hand with the finger and thumb, and transfix them opposite the carpo-metacarpal joint; then cut forward as far as the middle of the side of the first phalanx. Separate the soft parts from the outer and palmar surfaces of the metacarpal bone, extending the incision to the opposite side of the first phalanx as far as the level of the web, and so encircling the finger. Disarticulate by opening the joint on the outer side.

Amputation of the Thumb.—It is important to preserve as much of this digit as possible; however small a piece may be left, it will be more useful than any artificial substitute.

To remove the whole Thumb.—If the left require amputation, a long narrow bistoury commences the incision well on the palmar side of the carpo-metacarpal joint, and is carried over the dorsum as far as the web of the index finger, opening the joint in its course. The ball of the thumb is then transfixed, the point of the knife making its exit where the incision commenced, and a flap made by cutting outwards close to the metacarpal bone. This is then twisted out. In operating on the right thumb the flap is made first by transfixion, and then the dorsal incision. This bone may be disarticulated, for it has a separate synovial sac. Care must be taken of the radial artery at the ulnar side of the base of the metacarpal bone. The instruments required are similar to those for operation on the toes.

Amputation of the Wrist. Radio-

Carpal Disarticulation.—*Instruments required.*—1. Tourniquet. 2. Large bistoury or small amputating knife. 3. Torsion forceps. 4. Artery forceps. 5. Pressure forceps. 6. Ligatures. 7. Acupressure needles. 8. Saw or bone forceps. 9. Needle nippers. 10. Tenaculum. 11. Sutures. 12. Absorbent cotton or lint. 13. Wool. 14. Splints. 15. Bandages. 16. Oiled silk. 17. Sponges. 18. Mackintosh sheet. 19. Anæsthetic and inhaler. 20. Aseptic dressing. 21. Drainage tubes.

The following methods are used: (a) Circular; (b) Double flap; (c) External flap.

(a) *Circular.*—While an assistant draws up the skin, the surgeon makes a circular incision through the skin, three fingers' breadth below the joint, or an inch below the styloid process. The skin and cellular tissue are divided and dissected back as far as the joint; with another circular sweep the various tendons are divided, and the joint is then opened, the knife being passed beneath the styloid process of the radius, and carried in a curved direction to follow the convexity of the carpal bones. The styloid processes may be removed with the saw or bone forceps. The radial and ulnar arteries and some carpal interosseous branches will require to be secured. This is the best method.

(b) *Double Flap.*—The anterior flap should be marked out first from the palm, with the hand held supine and the thumb abducted; this is then raised by cutting from without inwards, avoiding the pisiform bone which projects. Next an incision, curved downwards, is made on the dorsum from one styloid process to the other, the flap raised, and the tendon divided. The hand is bent forcibly, the joint opened from the back, and traversed.

(c) *External Flap* (Dubrueil).—Commencing just below the level of the articulation while the hand is pronated, the surgeon makes a convex incision beginning at the junction of the outer and middle thirds of the arm behind, reaching at its summit the middle of the dorsal surface of the first metacarpal bone, and terminating in front just below the palmar surface of the joint; again at the junction of the middle and outer thirds of the breadth of the arm. This flap is raised, the joint opened at the outer side. A circular incision round

the inner side below the end of the ulna completes the skin incision. Disarticulation is then accomplished.

Amputation of the Forearm.—Instruments required.—1. Tourniquet. 2. Small amputating knife. 3. Torsion forceps. 4. Artery forceps. 5. Acupressure needles. 6. Saw. 7. Ligatures. 8. Needle nippers. 9. Tenaculum. 10. Sutures. 11. Absorbent cotton and lint. 12. Wool. 13. Splints. 14. Bandages. 15. Oiled silk. 16. Sponges. 17. Mackintosh sheet. 18. Anæsthetic and inhaler. 19. Aseptic dressing. 20. Drainage tubes. This operation, if possible, should be performed below the insertion of the pronator radii teres, to preserve the movements of pronation and supination to the stump. The tourniquet is applied to the brachial artery.

In the lower half, Teale's method is applicable, or the modified flap.

Long Rectangular Flap (Teale).—This flap is made from the back of the forearm. The radial vessels must be left for the shorter flap. In tracing the long flap a longitudinal line is drawn over the radius external to the vessels; at the distance of half the circumference of the limb another line is drawn parallel over the ulna. These are joined across the dorsum by a transverse line. The short flap is formed by a transverse line across the front joining the long ones at the upper fourth. In dissecting the long flaps from below upwards the tissues must be separated close to the periosteum and interosseous membrane. The stump is placed in the prone position to allow the long flap to fall over its face.

Modified Flap.—An anterior and posterior semilunar flap, about two inches long, are marked out and dissected back from without inwards, consisting only of the integument. The muscles, etc., are divided circularly down to the bones, and the knife passed between them; then the bones are sawn through together. The ulnar, radial, and interosseous arteries will require ligature.

In the *Upper Two-thirds* amputation can be effected by the circular method, or by double flap.

By Double Flap.—The dorsal flap is best made by cutting from without inwards, the knife being entered at the palmar surface of the ulna, carried

forwards parallel to that bone, then across the back of the arm in a curved direction, terminating at the palmar surface of the radius opposite where it commenced. The knife is then pushed in front of the bones, transfixing the limb, at the extremities of the dorsal incision, and a flap cut from the front. The dorsal flap is dissected up, the bones cleared, and the saw applied.

Amputation at the Elbow Joint.—This may be performed: (a) By anterior flap; (b) Circular; (c) External flap. The instruments required are the same as for amputation of the arm.

(a) *By Anterior Flap.*—The surgeon standing on the inner side of the limb to be operated on, the latter being supine and the forearm flexed to an angle of 35° , raises with his left hand the structures in front of the joint, the knife is then entered a finger's breadth below the internal condyle, and made to transfix the limb at two fingers' breadth below the external condyle, and a semilunar flap formed by cutting downwards and forwards. The flap must be at least three inches long. An assistant then draws up the skin at the back of the joint, and a semilunar incision is made connecting the points of transfixion at the back. The head of the radius is recognised and the joint opened by entering the knife between the radius and the humerus dividing the external lateral ligament. A few touches of the knife over the coronoid process will divide the capsule and the internal lateral ligament. The olecranon is then drawn forcibly downwards, and the triceps divided at its insertion, and the remaining tissues from within outwards.

Modifications.—Gross divides the ulna with a saw, leaving the olecranon, and removes the inner trochlea on a level with the general surface.

(b) *Circular.*—A transverse incision is made $3\frac{1}{2}$ inches below the inner trochlea. The skin and fascia are raised for an inch, then the muscles divided circularly; these are then forcibly retracted, and the deep muscles in front again divided transversely together with the external lateral ligament, on a level with the radial articulation. The disarticulation is performed as previously directed.

(c) *External Flap.*—This should only

be used where both the preceding methods are impossible. An external flap five inches long is made by transfixion at a point a finger's breadth below the bend of the elbow. A transverse incision is made across the inner side of the arm one inch below the points of transfixion. The joint is then opened and disarticulation performed.

Modification.—Two lateral flaps, but the outer half an inch longer than the inner.

Amputation of the Arm may be performed anywhere below the attachment of the axillary muscles.

Instruments required.—1. Tourniquet. 2. Amputating knife. 3. Saw. 4. Torsion forceps. 5. Artery forceps. 6. Ligatures. 7. Sutures. 8. Tenaculum. 9. Acupressure needles. 10. Wire nippers. 11. Strapping. 12. Lint and absorbent cotton. 13. Bandages. 14. Wool. 15. Straightsplint. 16. Sponges. 17. Mackintosh sheet. 18. Anæsthetic and inhaler. 19. Drainage tubes. 20. Aseptic dressing. For the circular: 21. Split linen retractor. 22. Round-pointed straight-edged knife.

Any method can be used, either: (a) Double flap; (b) Circular; (c) Modified flap; (d) Teale's rectangular flap.

(a) *Double Flap.*—The flaps may be antero-posterior, or lateral, made by transfixion. If antero-posterior, the surgeon stands on the inner side of the limb, raises the muscles with his left hand, and enters the knife just outside the brachial vessels, pushes it across, keeping close to the bone, and makes it issue at a point directly opposite by raising the handle. The flap is then cut by a brisk sawing movement, at first parallel to the bone, then slightly forward, and the knife brought out perpendicular to the surface. The posterior flap is formed by transfixing behind the bone, through the extremities of the wound; it should be slightly shorter than the anterior to allow for retraction of the biceps. The flaps are retracted, the bone cleared and sawn through one inch above the junction of the flaps. If lateral flaps be used these are made by transfixion from before backwards.

(b) *Circular* should be used in persons whose arms are very muscular. It is performed in the usual manner, but the biceps should be cut longer than the other muscles.

(c) *Modified Flap* is also useful in very muscular arms, the flaps being made by cutting from without inwards, and consisting only of skin and fascia.

(d) *Teale's Method* in suitable cases can be performed in this region. The internal line of the long flap is made just external to the brachial vessels, which are included in the short flap.

Amputation at the Shoulder Joint is required for malignant disease, injury, and aneurism.

Instruments required.—1. Tourniquet. 2. Long amputating knife. 3. Artery, torsion, and compression forceps. 4. Fine and strong ligatures. 5. Tenaculum. 6. Acupressure needles. 7. Needle nippers. 8. Key to compress the subclavian artery. 9. Sutures. 10. Strapping cut into strips. 11. Bandages. 12. Absorbent cotton or lint. 13. Oiled silk. 14. Sponges. 15. Caustery irons, or Paquelin's thermocautery. 16. Ice or hot water. 17. Mackintosh sheet. 18. Drainage tube. 19. Aseptic dressing. 20. Anæsthetic and inhaler. Four assistants are required, one to compress the subclavian, another to seize the axillary artery, a third to take charge of the limb, a fourth to assist in raising the flaps and controlling the vessels. The subclavian artery must be controlled by an assistant using digital pressure upon the first rib above the clavicle, or if the parts be deep the padded handle of a door key is used, or Esmarch's tourniquet encircling the axilla, scapula, and clavicle. Hæmorrhage is the great danger, and this must be avoided by leaving the axillary vessel intact until disarticulation be performed, and having a good assistant to seize the artery directly it is severed. Or the artery may be exposed and tied before being cut. Or a temporary ligature may be applied, by carrying a silver wire or silk ligature with a curved needle through the skin of the axilla and round the vessels, and tying it over a pad before the incisions are commenced. The chief methods of operation are: (a) Oval method; (b) Spence's method; (c) Double flap.

(a) *Oval method* (Larrey).—With a moderate-sized amputating knife make a straight incision immediately beneath the acromion process, reaching down to the bone, about $2\frac{3}{4}$ inches in length; from the lower end of this two other incisions are prolonged, one passing in a curved direction downwards and back-

wards, the other downwards and forwards towards the folds of the axilla, leaving the main blood-vessels and the inner or axillary aspect of the arm untouched. The flaps are then dissected back, including the muscles, and the joint exposed. The head of the bone is then disarticulated by cutting upon the tuberosities, the arm being rotated inwards and outwards. The arm is then adducted, throwing the head of the humerus outwards, and the knife passed to its inner side and carried downwards close to the bone, an assistant following it with his hands and compressing the artery. Finally, the tissues between the axillary folds are divided by an oblique cut from within outwards, so as to form part of the internal incision.

(b) *Spence's Method* is a modification of the oval, and an excellent operation. He thus describes it, supposing the right arm to be the subject of amputation: "The arm being slightly abducted and the head of the humerus rotated outwards, with a broad strong bistoury I cut down upon the inner aspect of the head of the humerus, immediately external to the coracoid process, and carry the incision down through the clavicular fibres of the deltoid and pectoralis major muscles till I reach the humeral attachment of the latter muscle, which I divide. I then, with a gentle curve, carry my incision across and fairly through the lower fibres of the deltoid, towards, but not through, the posterior border of the axilla. Unless the textures be much torn, I next mark out the line of the lower part of the inner section by carrying an incision through *the skin and fat only*, from the point where my straight incision terminated across the inner side of the arm, to meet the incision at the outer part. If the fibres of the deltoid have been thoroughly divided in the line of the incision, the flaps, along with the posterior circumflex artery, can be easily separated by the point of the finger from the bone and joint, and drawn upwards and backwards so as to expose the head and tuberosities without further use of the knife. The tendinous insertion of the capsular muscles, the long head of the biceps and the capsule are next divided by cutting directly on the tuberosities and head of the bone. Disarticulation is then accomplished, and the limb removed by dividing the remaining soft

parts of the axillary aspect." If the limb be very muscular, the skin and fat can be dissected at the lower part from the deltoid, and the muscular fibres divided higher up by a second incision.

(c) *Double Flap* (Lisfranc).—When the arm is abducted, if the right arm have to be operated on, the surgeon stands in front of the patient, the point of a long-bladed knife is passed midway between the coracoid and acromion processes, carried across the outer side of the joint, and brought out a little below the posterior border of the acromion (if the left limb be operated on, the surgeon stands behind the patient, and the transfixation is reversed). With the left hand he seizes the deltoid and raises it, works the knife round the head of the humerus, and cuts a full flap five inches long. The tendons of the supraspinatus and long head of the biceps are divided, and the subscapular and infraspinatus muscles partially divided in making this incision. The flap is held up by an assistant, the joint opened, the arm adducted, the knife passed to the inner side of the bone, and an inner flap cut from within outwards, as low down as the junction of the anterior fold of the axilla with the arm. An assistant secures the axillary artery.

Modifications.—If the skin have been destroyed on the inner side of the joint, a large deltoid flap can be used, the surgeon after disarticulating cutting out in a transverse direction, without making any inner flap. In this case, and where the amputation is performed for disease, the flaps should be dissected from without inwards with a broad bistoury. Amputation at the shoulder joint is very successful, particularly when primary.

The circumflex, subscapular, posterior scapular, and axillary arteries will require ligature.

Amputation of the Toes.—Instruments required for amputations of the metatarsal bones and toes.—1. Tourniquet. 2. Straight forceps. 3. Tenaculum. 4. Torsion forceps. 5. Artery and compression forceps. 6. Acupressure needles. 7. Needle nippers. 8. Ligatures. 9. Sutures. 10. Lion or necrosis forceps. 11. Strapping. 12. Absorbent cotton or lint. 13. Wool. 14. Bandages. 15. Narrow saw. 16. Bone forceps. 17. Mackintosh sheet. 18. Anæsthetic and inhaler. 19. Drainage tubes. 20. Aseptic dressing.

If it be necessary that one of the smaller toes should be removed, this should be effected at the metatarso-phalangeal joint; but in the case of the great toe, as much as possible should be preserved. The toes are removed in a similar manner to the fingers, by the oval method, care being taken to commence the incision further behind the web than in the hand, as the metatarso-phalangeal joint is at a greater distance. As a general rule the commencement of the incision should be as far behind as the end of the toe is in front of the web. The flap operation is not advisable, for it is important to avoid wounding the sole.

Amputation of the Great Toe and Metatarsal Bone may be performed by: (a) The oval method; (b) Internal flap.

(a) The incision commences on the dorsum a little behind the point at which the bone is to be divided or disarticulated, is carried forwards in a straight line to the metatarso-phalangeal joint as far as the extreme margin of the web, around this, and back to its starting-point. The soft parts are separated and the metatarsal bone carefully dissected up till the joint be reached, or the place where the bone has to be sawn. Care must be taken not to wound the dorsalis pedis artery, which dips into the sole of the foot close to the outer side of the joint. It is best if possible to amputate in continuity to preserve the insertions of the peroneus longus.

(b) *Internal Flap*.—This is a rapid method, but not to be recommended, as it involves the sole. The soft parts are raised on the inner edge by the left hand, with a strong broad bistoury the surgeon transfixes them at the tarso-metatarsal joint, keeping as close to the bone as possible, and forms a flap by cutting as far forwards as the middle of the first phalanx, the plantar aspect being cut as thickly as possible. The soft parts are then drawn outwards, and the knife being entered between the first and second metatarsal bones, in the former incision, cuts forwards through the centre of the angle between the great and second toes, to separate the metatarsal bone. The operator seizes the toe and presses it inwards, passes his knife into the angle of the wound and opens the joint, keeping the knife well against the bone.

Amputation of the Metatarsal Bone of

the Little Toe.—This operation is best performed by an oval incision beginning just behind the tubercle, carried forwards and inwards to the middle of the fourth interspace, and thence to the web of the toe, round the plantar surface back to the dorsum. The flap is dissected down, the knife passed round the under surface of the bone, the toe drawn outwards, and the ligaments divided.

Amputation of all the Metatarsal Bones at the Tarso-Metatarsal Joint (Hey and Lisfranc).—The line of junction of the metatarsal bones with the tarsus is irregular, the second metatarsal bone being locked in between the first and third cuneiform bones, and connected by a strong interosseous ligament. The guides to the articulation are the projecting bases of the first and fifth metatarsal bones, which should be recognised under the skin, and the finger and thumb placed as guides on these points. The surgeon cuts across the dorsum of the foot from the base of the fifth to the base of the first metatarsal bones (for the left foot this is reversed), and makes a curved incision, with the convexity forwards, beginning and ending in the sole. A plantar flap is then marked out, beginning and ending at the same places, but crossing the sole at the base of the toes. The dorsal flap is dissected backwards, the tendons and fibres of the extensor brevis divided, and the disarticulation proceeded with, using a short but strong knife, whilst the metatarsus is depressed. The joints between the fifth, fourth, and third metatarsals and tarsus should be opened from the outer side, and the first tarso-metatarsal joint from the inside. The joint between the second metatarsal and second cuneiform is sought for and opened, the knife being used first upward in a longitudinal direction, then transversely and steadily downwards; the part is flexed forcibly to aid disarticulation. The plantar flap is then cut from within outwards, turned up, and attached to the dorsal.

Modification.—Both flaps may be cut from within outwards. The second metatarsal bone may be sawn across to avoid the difficulty of disarticulation, or even all the metatarsal bones may be sawn across.

Medio-Tarsal or Chopart's Amputation.—The guides to the articulation are on the inner side the tubercle of the

scaphoid, which can be readily felt under the skin; on the outer, a point midway between the base of the fifth metatarsal bone and the external malleolus. The surgeon places his left forefinger and thumb on these points, and makes a curved incision from one to the other, across the dorsum, passing an inch in front of the head of the astragalus. The plantar flap is marked out by entering the knife at one of these points, carrying it forward for four or five fingers' breadth nearer the toes, then across the sole, and back to the other point. The dorsal flap is dissected up, the tendons, etc., divided, the joint opened between the astragalus and scaphoid, the surgeon bending the front of the foot forcibly, and the plantar flap cut from within outwards. The plantar flap is then turned up, and stitched to the dorsal. The arteries requiring ligature are the dorsalis pedis, and external and internal plantar.

Modifications. — Erichsen prefers making the plantar flap first, by cutting from within outwards, then disarticulating. Syme preferred making the plantar flap by transfixion before disarticulating. The projecting heads of the astragalus and articular surface of the os calcis may be sawn off. In some cases the heel is elevated after this operation by the action of the muscles of the calf; in such cases division of the tendo Achillis is advisable.

Subastragaloid Amputation (Tripier). — Commencing at the outer edge of the tendo Achillis on a level with the external malleolus, a skin wound is made in a direction at first downwards and forwards, then forwards so as to pass two fingers' breadth below the malleolus, and then approaching to within a finger's breadth of the base of the fifth metatarsal bone. From this point the incision is carried upwards, forwards, and inwards, so as to reach the inner margin of the tendon of the extensor proprius pollicis, just behind the first metatarsal joint. The plantar wound is now made by the knife cutting downwards and forwards, so that it will enter the sole of the foot a finger's breadth in front of the dorsal wound, and the incision is then prolonged, with a slight forward curve outwards and backwards, to join the first part of the wound, below the outer malleolus. The integument is retracted for half-an-inch, and the soft parts divided

and separated from the bone, particular care being taken of the vessel in the inner side of the plantar flap. The cuboid and scaphoid are disarticulated from the astragalus and os calcis, then the periosteum is divided and separated from the under surface and posterior extremity of the os calcis up to the level of the sustentaculum tali, where the bone is sawn through in a direction from behind and within, forwards and outwards, making a surface at right angles with the axis of the tibia when the limb is in an upright position. All sharp, bony edges and angles are rounded off, and the posterior tibial nerve exposed on the plantar flap, and divided as high as possible. By this operation all the foot is removed, except the astragalus and a small portion of the os calcis, the movements of the ankle joint being retained.

Modification. — Hancock removed a small slice of the lower surface of the astragalus to which the posterior part of the calcaneum was applied.

Syme's Amputation. — *Tibio-tarsal Amputation.* — *Instruments required.* —

1. Tourniquet. 2. Strong bistoury. 3. Strong scalpel. 4. Saw. 5. Bone forceps. 6. Artery and compression forceps. 7. Torsion forceps. 8. Tenaculum. 9. Acupressure needles. 10. Sutures. 11. Lint and absorbent cotton. 12. Strapping. 13. Sponges. 14. Bandages. 15. Ice and hot water. 16. Lion or sequestrum forceps. 17. Mackintosh sheet. 18. Anæsthetic and inhaler. 19. Drainage tubes. 20. Aseptic dressing. The same instruments will serve for Chopart's operation.

Syme describes the operation thus: "The foot being placed at a right angle to the leg, a line drawn from the centre of one malleolus to the other, directly across the sole of the foot, will show the proper extent of the posterior flap. The knife should be entered close up to the fibular malleolus, and carried to a point on the same level on the opposite side, which will be a little below the tibial malleolus. The anterior incision should join the two points just mentioned, at an angle 45° to the sole of the foot and the long axis of the leg. In dissecting the posterior flap the operator should place the fingers of his left hand upon the heel, while the thumb rests upon the edge of the integument, and then cut

between the nail of the thumb and the tuberosity of the os calcis, so as to avoid lacerating the soft parts, which he at the same time gently but steadily presses back, until he expose and divide the tendo Achillis. The foot should be disarticulated before the malleolar projections are removed, which is always proper to do, and which may be most easily effected by passing a knife round the exposed extremities of the bones, and then sawing off a slice of the tibia connecting the two processes." The points to be attended to are : 1. To take care that the incision across the sole does not extend further forwards than the most prominent part of the tuberosities of the os calcis ; 2. That the incision terminates half an inch below the external malleolus ; 3. That the knife be kept close to the bone in raising the flap, so that this may not be scored or its vascular supply interfered with.

Internal Lateral Flap (Roux) is used when the heel flap cannot be obtained. An anterior curved incision is made, commencing at the outer side of the tendo Achillis, a little above its insertion, passing under the external malleolus across the instep, half an inch in front of the lower edge of the tibia, and stopping just in front of the inner malleolus. The internal lateral flap is then made by cutting from the inner end of this incision, directly downwards into the sole as far as the junction of the middle and outer thirds, then in a straight line backwards to the heel, and upwards behind this to join the first incision. The edges of the flap are dissected up, the joint opened from the outer side, and the internal flap completed from within outwards after disarticulation. In a similar way an external flap may be obtained from the outer side if necessary.

Pirogoff's Amputation.—This is a modification of Syme's. An incision is made from the tip of the inner malleolus, to a point a little above and in front of the outer malleolus, crossing the dorsum half an inch in front of the lower end of the tibia. Another incision is made across the sole at the level of the calcaneo-cuboid articulation, joining the extremities of the first incision and reaching down to the bone. The flap is dissected back for two lines, and the dorsal flap to the joint, which is

opened by dividing the lateral ligaments. The foot is drawn forwards and forcibly bent downwards, and a narrow amputating or a Butcher's saw passed through the joint and applied to the upper and back part of the os calcis, behind the astragalus, and the bone sawn through obliquely downwards and forwards. The malleoli and a slice of the tibia are also removed with the saw. The cut surfaces of the bones must be adjusted accurately, and if considered advisable sutured together. The limb should be placed on the outer side, with the knee flexed to relax the tendo Achillis. This operation is only applicable to cases of injury.

Amputation of the Leg may be performed in the lower third, middle third, or upper third. The junctions of the lower and middle thirds and the upper and middle thirds are the best points. The popliteal artery is controlled by a bandage placed between the hamstrings, and a tourniquet applied outside this.

Instruments required.—1. Tourniquet. 2. Amputating knife. 3. Scalpel. 4. Bone forceps. 5. Saw. 6. Torsion forceps. 7. Artery forceps. 8. Ligatures. 9. Sutures. 10. Tenaculum. 11. Compression forceps. 12. Strapping. 13. Hare-lip pins. 14. Wire nippers. 15. Absorbent cotton and lint. 16. Bandages. 17. Oiled silk. 18. Caustery irons or Paquelin's thermo-caustery. 19. Hot water and ice. 20. Sponges. 21. Mackintosh sheet. 22. Anæsthetic and inhaler. 23. Drainage tubes. In circular amputations a round-pointed knife and linen retractor are necessary.

(a) *Lower Third.*—The best methods are : 1. The circular ; 2. Modified circular ; 3. Long anterior flap ; 4. Elliptic posterior flap.

1. *Circular.*—This is performed in the usual manner, four fingers' breadth below the place of section of the bones. The fibula should be cut first, then the tibia.

2. *Modified Circular.*—In this method a longitudinal incision is made, in addition to the circular, on the anterior external aspect, and this assists greatly in raising the skin. If necessary, an incision may be made on each side and the corners rounded off (modified flap). The disadvantages of these modes of operation is that the resulting cicatrices are central, and the stump cannot bear the weight of the body.

3. *Long Anterior Flap* (Bell).—A long anterior flap, equal in length to the diameter of the leg at its base, is made from without inwards, beginning at the posterior edge of the tibia on the inner side, just below the place where the bones are to be sawn, and ending at a corresponding point over the fibula. The anterior muscles are divided half an inch above the lower end of the flap, and dissected off the bones and interosseous membrane,—care being taken, in separating the parts from the latter, of the anterior tibial artery, to avoid puncturing which only the finger or handle of the scalpel should be used. The posterior flap is made by cutting through all the tissues with one bold transverse stroke of the knife. The resulting cicatrix is posterior and not adherent to the bone.

4. *Elliptic Posterior Flap*—*Supra-Malleolar* (Guyon).—The incision should begin an inch above the line of the division of the bones, and be carried downwards to the heel, crossing this below the insertion of the tendo Achillis, and returning on the opposite side to where it commenced. The tendo Achillis is divided at its insertion, and the flap raised posteriorly as high as the upper end of the ellipse, keeping close to the bones. The anterior muscles are divided by transfixion, the bones sawn, and the posterior tibial nerve resected. The patients can bear their whole weight on this stump.

(b) *Middle Third of the Leg*.—The methods available here are: 1. Long anterior curved flap; 2. Long anterior rectangular flap (Teale); 3. Long posterior rectangular flap (Lee); 4. Simple posterior flap; 5. Short anterior and long posterior flap (Hey).

1. *The Long Anterior Curved Flap* is made as in the lower third, care being taken that it is sufficiently long, and to saw off obliquely the sharp angle of the spine of the tibia.

2. *Long Anterior Rectangular Flap* (Teale) is performed as directed previously, the long incision beginning at each end of the transverse diameter of the limb, and proceeding downwards and slightly backwards, so that they shall be as far apart at their ending as at their commencement. The outer longitudinal line of the long flap is first marked along the posterior edge of the fibula, the inner over the posterior edge of the

tibia, and the two are joined below by a transverse line passing in front of the ankle joint. The short flap is then marked. The two lateral incisions are traced merely through the skin, whilst the transverse one is carried through the skin and all the other structures down to the bones. The long flap is then dissected upwards, in doing which the whole of the tissues situated in front of the tibia, interosseous membrane, and fibula are to be separated *close* to the periosteum and membrane, to avoid division of the anterior tibial vessels at the lower end of the flap. The short flap is made by a direct cut through all the structures down to the bone and interosseous membrane, from which parts they are to be separated upwards, close to the periosteum and membrane, as high as the intended point of section of the bone.

3. *Long Posterior Rectangular Flap* (Lee) is performed according to Teale's method, but the long flap is made from the back. The incision only involves the skin. "When the skin had somewhat retracted by its natural elasticity, an incision was made through the parts situated in front of the bones, which were reflected upwards to the level of the upper extremity of the first longitudinal incision. The deeper structures at the back of the leg were freely divided in the situation of the lower transverse incision. The conjoined gastrocnemius and soleus were separated from the subjacent parts, and reflected as high as the anterior flap. The deeper layer of muscles, together with the large vessels and nerves, were divided as high as the incision would permit, and the bones sawn. The posterior flap is then brought forward and attached to the anterior."

4. *Simple Posterior Flap*.—This can be used when the muscles are wasted. A transverse incision is made in front of the leg, from the posterior edge of one bone to that of the other; then a posterior flap, equal in length to the diameter of the leg at its base, is cut from within outwards, by transfixion.

5. *Short Anterior and Long Posterior Flaps*.—The circumference of the limb is measured, and an anterior flap made equal in breadth to two-thirds of the circumference, and one inch in length. The posterior flap is made by

transfixion, one-third of the circumference in length and breadth. The interosseous arteries are divided half an inch below the point of section of the bone.

(c) *Upper Third of the Leg.*—The bones must not be divided higher than the attachment of the ligamentum patellæ, and the head of the fibula must be retained, as its joint occasionally communicates with the knee joint. The modes of operation are: 1. Circular; 2. Long rectangular and single anterior or posterior flaps; 3. External flaps; 4. Modified flap.

1. *Circular.*—This is performed in the usual manner, beginning four fingers' breadth below the point where the bones are to be sawn. The gastrocnemius and soleus are cut longer than the deeper muscles, to allow for their greater retraction.

2. *Long Rectangular and Single Anterior and Posterior Flaps* are performed as in the middle third.

3. *External Flaps* (Sédillot).—The foot is extended, and the knee joint bent to an angle of 45° by an assistant. The point of the knife is entered a finger's breadth outside the crest of the tibia, carried backwards and upwards, grazing the fibula and brought out posteriorly as far to the inner side as possible, one inch higher than where it entered. The soft parts should be seized and raised by the operator's left hand, to form as broad a flap as possible. A gently rounded flap, four fingers' breadth in length, is cut from within outwards. Across the front and inner side of the limb a skin incision, slightly convex downwards, is made, joining the extremities of the first incision. The skin is then reflected, and the muscles divided at the base transversely. The bones are then sawn, and the flaps stitched together.

4. *Modified Flap* (Bell).—Two equal semilunar flaps of skin must be cut from without inwards, one anterior and external, the other posterior and internal, their ends meeting at a point two inches below the tuberosity of the tibia on either side. These are reflected, and with them a further extent of skin, embracing the whole circumference of the limb, must be dissected up, exposing the bone one inch below the tuberosity. The anterior muscles must be cut as high as exposed, and the posterior ones

about the middle of their exposed surfaces. The bones are sawn as high as they are bared, the fibula being finished first, and the sharp crest of the tibia removed.

In these operations on the leg, the anterior and posterior tibials, peroneal, and interosseous arteries require ligatures.

Amputation at the Knee.—(a) *Long Anterior Flap and Short Posterior.*—The patella and articular cartilage of the femur should be preserved, unless diseased. A square flap, with the corners rounded off, is formed by an incision beginning half an inch below the articulation, as far back as the posterior border of the condyle, carried down for four or five inches, then across the front of the leg, five inches below the patella, and then upwards to a point corresponding to where it commenced at the back of the other condyle. This flap is raised, including the patella, from the front of the joint which is opened. The ligaments are divided and the limb forcibly flexed, the knife passed through to the back of the joint, its edge turned downwards, and a short flap formed by cutting boldly downwards and outwards. It is advisable to turn up the anterior flap, and divide the tendon of the quadriceps extensor, to avoid the patella being tilted up.

Modification.—Pancoast makes two skin semilunar posterior lateral flaps, meeting in the centre of the popliteal space, and a small semilunar flap, containing the patella.

(b) *Oval Method* (Bauden's).—An oval incision is made, crossing the leg five fingers' breadth below the lower border of the patella, whilst behind it is three fingers' breadth higher than in front, only implicating the skin. The anterior flap, including the flexor tendons on the inner side of the tibia, is dissected up, until the lower border of the patella be reached. Then the leg is forcibly flexed, the ligamentum patellæ divided, and disarticulation proceeded with as before, the remaining soft parts behind the joint being divided from within outwards. This incision can also be used for amputating through the condyles, when it should only extend three fingers' breadth below the patella, and the joint be opened above that bone. The condyles are sawn through after disarticulation.

Amputation through the Condyles (Carden).—Anterior Flap.—"The operation consists in reflecting a rounded or semi-oval flap of skin and fat from the front of the joint, dividing everything else straight down to the bone, and sawing the bone slightly above the plane of the muscles; thus forming a flat-faced stump, with a bonnet of integuments to fall over it. The operator standing on the right side of the limb seizes it with his left forefinger and thumb at the spots selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round, through the skin and fat below the patella, to the spot pressed by his thumb; then turning the edge downwards, at a right angle with the line of the limb, he passes it through to the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards, and the saw applied." "Or, the flap may be reflected first, and the knee examined, particularly if the operator be undecided between resection and amputation. In amputating through the condyles, the patella is drawn down by flexing the knee to a right angle, before dividing the soft parts in front of the bone; or, if that be inconvenient, the patella may be reflected downwards. The flap falls easily over the end of the bone, and when united to the posterior integuments by a few pins and sutures, is drawn strongly upwards and backwards by the gently retracted flexors, and has a somewhat puckered and redundant aspect at first. Whatever dressing may be used, it is of great importance to loosen it, and examine the stump early, and to carefully provide for the free escape of serum. I remove the pins and sutures at from twenty-four to forty-eight hours at furthest."

Modifications.—Bell advises, after the anterior flap is removed and the knee disarticulated, that a posterior flap an inch in length should be formed of skin only, and allowed to retract before dividing the muscles. Lister cuts transversely across the limb from side to side at the level of the anterior tuberosity of the tibia, and joins the horns of this incision posteriorly by carrying the knife

at an angle of 45° degrees to the axis of the leg, through the skin and fat. The posterior skin flap is dissected up and the integuments raised as in a circular operation, the hamstrings are divided as soon as exposed, and the knee being bent, the upper border of the patella is clearly seen. By this operation there is no anterior flap, the integuments being divided transversely as in the old circular operation, but there is a short posterior skin flap; by this means the chance of the skin on the anterior aspect sloughing is much diminished.

Gritti's Modification consists in retaining the patella, from which a thin slice is removed, in the anterior flap, and applying it to the cut surface of the condyles in a like manner to Pirogoff's amputation.

In all these operations the bone should be sawn, transversely to the axis of the limb, not of the bone.

Amputation of the Thigh.—The tourniquet must be applied as high as possible, and if in the way in amputation in the upper third, digital compression must be used. Lister advises that if the band of the tourniquet prevent retraction of the muscles, the bone should be divided wherever it is most convenient, and the excess sawn off after the vessels have been tied.

Instruments required are the same as for amputation through the leg.

Lower Third of Thigh.—Teale's and Carden's where the skin over the patella is uninjured; in other cases the modified flap or long anterior flap.

In Teale's Operation the chief point to be observed is that the inner line of the long flap should be traced *as near as practicable* to the femoral vessels, without including them within it. Attention to this circumstance is necessary in order that the long flap may be as much anterior as possible.

Modified Flap (Syme).—Two equal semilunar flaps of skin are raised from the fascia, the one anterior, the other posterior, with their convexities towards the knee, and retracted two inches further; the muscles are divided right down to the bone, on a level as *high* as they are exposed in front and as *low* as they are exposed behind. The bone is cleared and sawn through two inches higher than where it was first exposed by the anterior incision through the muscles.

Long Anterior Flap (Sédillot).—The flesh of the anterior aspect of the limb is grasped in the left hand, and an incision made through the skin, marking out a flap whose length is equal to one-third and its base almost to two-thirds of the circumference of the limb. The muscles are then divided obliquely upwards and backwards, so that the flap shall not be too thick, the posterior segment of the limb divided transversely, the bone cleared an inch or two higher, and sawn through.

Modification. — Spence makes the anterior flap as low as possible, so that its lower margin is below or on a level with the lower border of the patella; when the skin is retracted above that bone he cuts down obliquely on the femur, so as to divide the soft parts up to the base of the flap. For the posterior incision he begins two fingers' breadth below the base of the anterior flap, and divides the soft parts obliquely. When the bone is cleared and the flaps retracted the femur is elevated and sawn through two inches above the base of the flap.

Middle and Upper Thirds of the Thigh. —The antero-posterior flap is to be used. If the right thigh have to be operated on the surgeon stands on the inside of the leg, raises the tissues on the front of the limb with his left hand, and transfixes just in front of the vessels, the flap including an exact half of the limb. The knife is brought out with a sawing motion, cutting a sufficiently long flap, introduced at the same places but behind the bone, and the posterior flap cut from within outwards. The flaps are retracted, the bone cleared, and then sawn.

Modification.—If the patient be emaciated Erichsen advises the posterior flap should be cut by transfixion, and the anterior from without inwards. If the patient be very muscular, skin flaps should be used. A long anterior flap is serviceable when the tissues at the back are not available.

Amputation through the Hip Joint.—The great risk in this operation is from hæmorrhage, particularly from branches of the internal iliac. This is best controlled by Davy's lever, introduced into the rectum. "The lever is turned out of ebony, and varies in length from eighteen to twenty-two inches. Its surface is very smooth and polished, and its ends

rounded off much like the finger tips. The maximum transverse diameter is five-eighths of an inch, the minimum, three-quarters of an inch. The rectal end is graduated to an inch scale, so that the surgeon who applies the lever can at once learn its whereabouts." The lever well oiled is introduced per rectum (emptied with an enema), for about nine inches, and the end applied over the common iliac artery, between the lumbar bodies and psoas magnus muscle. The handle of the lever is parallel with the opposite thigh; compression is made by lifting the handle, the perineal tissues acting as a fulcrum. If this cannot be used, Jordan Lloyd recommends elastic pressure with an india-rubber bandage. The limb is first emptied of blood, and two yards of Martin's bandage doubled and passed between the thighs; a roller bandage is placed over the external iliac, and then the ends of the bandage are firmly and steadily drawn by an assistant upwards and outwards, one in front and the other behind, to a point above the centre of the iliac crest on the same side. Compression of the abdominal aorta by Lister's tourniquet a little above the iliac crests, the pad being screwed down, with a small sponge intervening between it and the skin, upon the pulsating vessel. Esmarch's elastic tourniquet is also used, applied round the belly with intervening pads. The elastic band should not completely encircle the body, but should be connected with the ends of a rigid object placed behind the back, and extending laterally beyond the sides of the body; a narrow piece of board with two lateral notches will serve the purpose (Lister). An elastic bandage must always be applied, just before the operation, from the toes upwards, to empty the limb of its blood. Three assistants are required, one to seize the femoral artery when divided, a second to take charge of the limb and assist in disarticulating, a third looks after the apparatus used to control hæmorrhage.

Instruments required.—1. Davy's lever. 2. Aorta compressor. 3. Elastic bandage. 4. Esmarch's elastic tourniquet and bandage. 5. Long hip knife. 6. Artery forceps. 7. Ligatures. 8. Torsion and compression forceps. 9. Tenaculum. 10. Acupressure needles. 11. Needle nippers. 12. Sutures. 13. Absorbent cotton or lint. 14. Strapping.

15. Sponges. 16. Bandages. 17. Ice and hot water. 18. Lion forceps. 19. Mackintosh sheet. 20. Anaesthetic and inhaler. 21. Aseptic dressing. 22. Drainage tubes.

Methods of Operation.—(a) Circular. (b) Long anterior flap. (c) Antero-posterior flaps. (d) Modified oval. (e) Low method.

Circular Method.—The patient lies on his back with the thigh overhanging the end of the table, a circular incision is made through the skin six inches below the anterior superior spine of the ilium, the skin retracted, and the muscles divided successively at higher levels until the femur be reached. The capsule is divided in front and on the sides close to the acetabulum, the head dislocated forwards by the assistant bringing the leg downwards and outwards, the knife passed behind, dividing the ligamentum teres, back of the capsule, and the muscles attached to the trochanter and neck.

Long Anterior Flap.—The patient being in the same position, and the thigh slightly flexed and abducted, the point of a long amputating knife is entered midway between the anterior superior spine of the ilium and the great trochanter, and passed inwards and backwards to the inside, appearing between the tendon of the adductor longus and the tuber ischii, passing close to and opening the capsule of the joint. Care must be taken not to wound the scrotum or opposite thigh. (For the right thigh the direction is reversed.) The knife is then carried downwards, with a rapid sawing movement, making a broad, well-rounded flap, equal in length to half the thigh. The fingers of the assistant must be inserted into the wound, and compress the femoral artery before it is divided. The flap is turned up and disarticulation effected, the limb being abducted and everted forcibly by dividing the capsule and ligamentum teres. Lastly, the leg is adducted and inverted, to bring the trochanter forwards, the knife passed behind the bone, and all the structures divided posteriorly in a perpendicular direction. The vessels in the posterior segment should be secured first, hæmorrhage meanwhile being controlled by sponges or compression forceps.

By Antero-Posterior Flaps is performed in a similar manner to the preceding, but the anterior flap is shorter, and a corresponding one is cut out of the soft parts at the back of the thigh after disarticulation. External and internal flaps may be similarly made if the skin do not allow of antero-posterior ones.

Modified Oval.—The patient is placed on his sound side with his hips at the foot of the table. A straight incision, three inches long, is made, beginning one inch above the great trochanter, and carried along its posterior border; then a circular incision is drawn from the lower end of the first round the thigh, passing three inches below the ischial tuberosity. The incision only involves the skin, which is reflected for one inch, and the muscles of the outer side divided obliquely upwards towards the joint. In front this division is not to be carried beyond the rectus muscle, but behind as extensively as possible and close to the bone. The thigh is flexed and adducted, the capsule is opened first longitudinally on the finger as a guide, then forwards and backwards along the edge of the acetabulum. An assistant protrudes the head of the femur backwards and outwards, the knife is passed behind it and brought down along the inner side of the bone, nearly to the level of the circular incision, when it cuts its way out on the inner side.

Low Method (Furneaux Jordan).—An incision is made, commencing above the great trochanter, and prolonged downwards along the outer side of the limb to one-third or half-way down the limb, or even to near the knee, being six or more inches in length. The joint is opened and disarticulated, and the shaft of the femur cleared from muscular attachments—which are here mostly loose and cellular—care being taken not to touch the bulky soft parts at the inner and upper parts of the thigh. The soft parts are then divided circularly at the lower end of the vertical incision where they are smallest. The boneless thigh should be firmly held and somewhat flattened as it is cut across. The skin must be retracted with the knife before complete section of the muscles. The long fleshy stump soon retracts and becomes shortened.

SECTION XIII.

CHAPTER XLIII.

OPHTHALMIC.

Inflammation of the Conjunctiva.—Varieties: 1. Catarrhal ophthalmia; 2. Pustular ophthalmia; 3. Ophthalmia neonatorum; 4. Purulent ophthalmia; 5. Gonorrhœal ophthalmia.

1. *Catarrhal Ophthalmia—Acute Conjunctivitis.* *Causes.* Predisposing: Ill health, and over-use of the eye. Exciting: Atmospheric influence; a draught of cold air directed in the eye; foreign bodies in the eye; exposure of the eye to a strong light; foul atmosphere; subsequent to the exanthemata; errors in refraction; affections of the eyelids or lachrymal passages; contagion.

Symptoms.—1. Heat, itchiness and smarting at the borders and angles of the eyelids, and a feeling of something gritty in the eye. 2. Redness of the conjunctiva, most marked at the circumference and fading towards the cornea, the surface being covered with a network of irregular meshes, which can be moved over the surface of the eye by rubbing the lid over them, and can be emptied by slight pressure. Interspersed spots of ecchymosis. 3. Lachrymation, followed by a muco-purulent discharge. 4. Slight intolerance of light. 5. Lids red and swollen, particularly at the edges, and gummed together in the morning. 6. Cornea clear and pupil active. 7. Semilunar fold and lachrymal caruncle are red and swollen. 8. Slight feverishness. 9. Slight pain. Generally both eyes are attacked simultaneously or successively.

Treatment.—Rest, quiet, iced compresses. Tepid lotions of sulphate of zinc (gr. ij to ʒj), or alum (gr. ij to ʒj). A solution of nitrate of silver (gr. ij to ʒj) should be dropped into the eye two or three times a day, provided the inflammation be limited to the conjunctiva. The lids must be smeared with boracic ointment. If the inflammation persist, two or three leeches should be applied as close as possible to the eyelids, but not

on them. Protect the eye with neutral glasses.

Constitutional.—A purgative of calomel and jalap, followed by Dover's powder, or a mixture of tr. aconit. m iv, vin antimon. m iv, liq. ammon. acet. ʒj, aquæ ad. ʒj, every four hours. After the febrile symptoms have disappeared, tonics, as iron, bark, quinine, and generous diet.

Chronic Ophthalmia.—Causes. Exceptionally it succeeds to the acute form. Ill health. Straining the eyes at fine work. Errors in refraction.

Symptoms.—1. Intolerance of light and lachrymation. 2. Eye is red and irritable. 3. Caruncle and lids red and prominent. 4. Increased secretion. 5. Eye is soon tired by reading, etc.

Treatment.—Absolute rest, all fine work being forbidden. Improve the general health.

Locally.—Lotions of alum or sulphate of zinc. Drops of nitrate of silver (gr. ij to ʒj), ung. hydrarg. nitratis dil. to the edges of the lids. A blister the size of a shilling to the temple or behind the ear. If these fail, a seton in the temple. All errors of refraction must be remedied by appropriate glasses.

2. *Pustular Ophthalmia—Phlyctenular Conjunctivitis—Apthous Ophthalmia.*

Causes.—It occurs in children and young adults, especially females. Exposure to draughts. Digestive disturbances. Common in strumous children.

Symptoms.—1. The sclerotic conjunctiva presents one or several small scarlet elevations, at a tenth or twentieth of an inch from the margin of the cornea, produced by enlarged blood-vessels. In the centre the scarlet spots are less and appear whiter than the base, from aggregation of leucocytes. 2. Cornea is clear. 3. No decided lachrymation. 4. Increased Meibomian discharge. 5. Slight pain or intolerance of light.

Diagnosis.—This is made from stru-

mous ophthalmia by the cornea being unaffected.

Treatment.—Hydrarg. c. creta followed by tonics.—Locally: Yellowoxide of mercury ointment (Pagenstecher's ointment R Hydrarg. peroxid. præcip. gr. xxx, vaseline ʒj): calomel dusted on the pustules, or lotions of sulphate of zinc or acetate of lead (gr. ij to ʒj). In severe cases a blister to the temple.

3. *Ophthalmia Neonatorum* (or Purulent Ophthalmia of Newly-born Infants).

Causes.—Application of vaginal discharges to the eye during parturition. Infection from contact.

Symptoms commence usually on the third day after birth, and always within the first week. 1. Slight discharge from the eyes, eyelids glued together after sleep. The palpebral conjunctiva is red and swollen. One eye is first affected, and the other a day or two after. 2. Discharge becomes sero-muculent. Palpebral conjunctiva red, swollen, and velvety. Sclerotic conjunctiva red and injected. 3. Swelling of the eyelids increases, the skin being red, tense, and shining; the discharge becomes purulent, of a deep yellow colour, and is formed in immense quantities. Sclerotic conjunctiva is in a state of chemosis. Eversion of the lids is often present.

Results.—Corneitis, ulceration, sloughing, prolapsus iridis, staphyloma, cataract, strabismus.

Prognosis.—If the cornea be unaffected recovery generally ensues under proper treatment.

Treatment.—Locally: Every half-hour the lids must be separated and the surface of the conjunctiva syringed with warm water, and afterwards with alum lotion (gr. v—x to ʒj), or sulphate of zinc (gr. ij to ʒj). The lids must be smeared with iodoform ointment. The surgeon himself must drop into the eye, once a day, nitrate of silver drops (gr. ij to ʒj). To relieve tension, scarification of the palpebral conjunctiva and lids if much swollen, and they can be everted. In cases where the lid cannot be everted, division of the outer canthus as far as the outer angle of the orbit, or vertical division of the upper lid.—General: The infant should be suckled and not brought up by hand. Castor oil or rhubarb and magnesia to regulate the bowels. Liquor cinchonæ m iv—v in milk twice a day.

As a prophylactic the infant's eye should be washed with an antiseptic immediately after birth.

4. *Purulent Ophthalmia—Contagious Ophthalmia—Egyptian Ophthalmia.*

Causes.—Contagion. Epidemic sometimes. It is apt to break out where large numbers of people are crowded together in barracks, workhouses, etc. Fatigue, exposure, intemperance, and unhygienic conditions. Extreme heat and dust.

Symptoms.—In slight cases those of catarrhal ophthalmia. Both eyes are commonly affected, but often with an interval of some days. The symptoms are frequently preceded by the formation of sago-grains, or follicular granulations, chiefly at the outer part of the lower lid, where the conjunctiva is reflected on the eyeball. These are greyish red, semi-transparent, round or oval, and consist in accumulation of lymph cells enclosed in the meshes of a delicate reticulum, and encapsuled by a condensation of the normal tissue (Pollock).

1. Swelling and œdema of the lids, the papillæ of the palpebral conjunctiva become enlarged from inflammatory congestion, and finally hypertrophied, forming granulations (granular lids). The lids are red, hot, and tense.

2. Discharge at first sero-muculent, then muco-purulent; this is formed in great quantities.

3. Sclerotic conjunctiva red and swollen, raised up into a roll all round the cornea overlapping the margin (chemosis).

4. Eversion of the lids is apt to occur.

5. Extravasation of blood.

6. Ulceration of the cornea beginning at the edge which is pressed upon by the chemosed conjunctiva. Sloughing of the cornea occasionally ensues.

7. Burning hot pain in the eyelids. Pain round the orbit, in the temple, and side of the head, occurring in paroxysms, worse at nights.

8. Depression of spirits, and failure of strength.

Results.—Chronic inflammation, granular conjunctivitis, ulceration or sloughing of the cornea, nebula or leucoma, prolapsus iridis, and staphyloma.

Prognosis.—Favourable if treated early, unfavourable when severe or neglected from the outset.

Treatment.—Isolate the patient, to

prevent the disease spreading. A diet of meat or beef tea with stimulants. Fresh raw arterial bullock's blood is a most valuable nutriment in these cases. Pure air is necessary. A purgative should be given at the commencement ; then quinine, or the mineral acids and cinchona. Opium in full doses every night, or hyoscyamus.—Locally : Nitrate of silver gr. x to xxx in $\bar{3}j$ of water is to be painted over the conjunctiva of the lids, which is then washed with salt and water (gr. v to $\bar{3}j$) ; this should be repeated every day, and be followed by iced compresses. If the lids be so swollen that they cannot be everted give an anæsthetic, and use toothed forceps to evert the lids. The eye must be bathed and syringed frequently with tepid solution of alum, bichloride of mercury (gr. $\frac{1}{8}$ to $\bar{3}j$), or tannin. Iodoform, 4 per cent., with vaseline, is of great service ; it should be applied under the upper lid with Bader's glass syringe, which has a flattened nozzle. If there be much chemosis, three or four incisions are to be made with the scissors through the swollen conjunctiva close to the cornea. Granular conjunctivitis is apt to remain, and the treatment must be directed to this condition.

5. *Gonorrhœal Ophthalmia.*—*Causes.* Inoculation of the eye with gonorrhœal matter. Bathing the eye with urine, a remedy for sore eyes among the lower classes.

Symptoms.—The same as in purulent ophthalmia, but the sclerotic conjunctiva is sooner affected, and in a greater degree, while the palpebral conjunctiva is less implicated. The cornea is very liable to suffer, leading to destruction of the eye. Males are more frequently attacked than females. The disease is limited to one eye as a rule, unless the other should be accidentally inoculated.

Prognosis.—Unfavourable, the disease frequently terminating in loss of sight in a few hours.

Treatment.—Protect the other eye. This is best done by Buller's shield, consisting of a watch-glass fastened in the centre of a square piece of mackintosh, fixed by adhesive plaster to the forehead and nose by its upper and inner margins.—General : Tonics, stimulants, and generous diet. A purgative, followed by mineral acids, bark or quinine. Opium, in a full dose at bedtime.

Local Treatment.—The same as for purulent ophthalmia, iced compresses and iodoform ointment being especially useful. Any ulcers on the cornea should be touched with solid nitrate of silver.

Granular Conjunctivitis—Granular Lids—Trachoma.

Causes.—The result of purulent ophthalmia or long-continued conjunctivitis. Contagion. General unhygienic conditions.

Symptoms.—When arising from contagion it generally begins as small, greyish, semi-transparent elevations (follicular or sago-granulations : *vide* Purulent Ophthalmia), which after a time occasion hypertrophy of the papillæ of the lids. The other form of granulations which are present is the *papillary*, due to hypertrophy of the papillæ of the lids and inflammatory exudation into the connective tissue. At first the granulations are highly vascular, and bleed ; later they become converted into cicatricial tissue. The cornea becomes hazy and vascular (trachomatous pannus), which is the result of friction or extension of the disease along the conjunctiva. The symptoms are worse if the patient be exposed to a strong light or cold winds. The eye is liable to be attacked by acute ophthalmia from slight causes.

Results.—Entropion ; distichiasis ; narrowing of the palpebral fissure.

Treatment.—Strong solution of nitrate of silver (grs. v—xxx to $\bar{3}j$), painted over the fully-everted lid, cocaine being previously applied. Dusting finely powdered acetate of lead over the palpebral conjunctiva, provided the cornea be unaffected. Sulphate of copper or lapis divinus (sulphate of copper, nitrate of potash, and alum fused together in sticks). Liquor potassæ undiluted. Tannin ointment (tannin gr. iiij, vaseline $\bar{3}iij$) ; sulphate of copper ointment (sulphate of copper gr. iiij, vaseline $\bar{3}iij$) ; yellow oxide of mercury ointment. A piece of these ointments, the size of half a pea, should be put in the eye once a day. Electrolysis to the granulations, using a current of about two milliamperes. Wolfe recommends scarification of the granular surfaces, and the subsequent application of a solution of tannin in syrup ($\bar{5}j$ to $f\bar{3}j$), together with friction of the conjunctival surfaces

against each other. Counter-irritation by blisters to the temples, and tr. of iodine to the skin of the lids. Good diet, tonics, bracing air. In bad cases, when the whole of the cornea is attacked by pannus, inoculation by a drop of matter from a case of purulent ophthalmia. A safer method is to bathe the eye with an infusion of jequirity (154 grs. of the seeds macerated in 3iij of water for twenty-four hours), three times a day for three days, which will cause a purulent ophthalmia, and this must be allowed to run its course untreated, in which case the cornea will clear considerably. This method is often very efficacious, but, of course, there is the risk of sloughing. Peritomy, or excision of a circumcorneal zone of conjunctiva.

Pterygium is a fleshy-looking growth of conjunctiva, consisting of blood-vessels and fibrous tissue, of a triangular shape, extending from the inner canthus to the cornea, or even overlapping this. The apex is of a grey colour, firmly attached to the cornea, but not invading its substance deeply; the main part of the growth is more vascular than the adjacent conjunctiva, the sides are free and formed by a double fold of mucous membrane. It is only loosely attached to the sclerotic.

Causes.—It is met with above the middle of life, and in persons who have lived in hot climates. Exposure to wind or dust, or anything which will produce chronic ophthalmia. The exciting cause is usually an ulcer of the cornea.

Treatment.—Ligature at the apex, base and deep surface. Excision. Transplantation, the apex being dissected up and attached by sutures to the conjunctiva below the cornea, where it will be covered by the lower lid, or turned back on the main part of the growth and fastened to its deeper surface (Nettleship).

Pinguecula is a small tumour on the conjunctiva, close to the edge of the cornea. It is of a yellowish white colour, composed of connective tissue and elastic fibres. It is perfectly harmless.

Treatment.—It can be snipped off with curved scissors if the patient wish.

Injuries to the Conjunctiva.—Sub-conjunctival hæmorrhage or ecchymosis arises from blows, coughing or vomiting, occasionally from straining efforts, as in

parturition. It forms a bright red patch, which passes through the usual colours of a bruise.

Treatment.—Cold applications. Evaporating lotions.

Laceration of the Conjunctiva, by striking the eye against something projecting, may require a fine silk suture, but as a rule it is only necessary to close the eyelids and use water dressing. Afterwards a lotion of sulphate of zinc.

Burns arise from escharotics, hot metals or liquids. If occasioned by caustic alkalies, apply a dilute acid and afterwards castor-oil and water dressing. If due to corrosive acids, a weak alkali; the eye must be well washed with water. All foreign bodies must be removed with the scoop. The after effects, as symblepharon, etc., must be treated in the manner hereafter directed.

Diseases of the Cornea.—Corneitis, Keratitis, or Inflammation of the Cornea.

Causes.—It occurs in children and young persons, especially those who are underfed, or improperly fed, and of a weak and unhealthy constitution.

Symptoms.—Objective: 1. Pinkish redness of sclerotic round cornea (sclerotic zone). 2. Haziness of the cornea, which looks like ground glass; this is often more marked in one place than another. 3. Lachrymation. As the disease subsides the surrounding vessels shoot into the substance of the cornea, forming a velvety patch (pannus), which is followed by clearing up of the cornea, though this is a process of long duration.—*Subjective*: 1. Feeling of grittiness. 2. Great intolerance of light. 3. Pain in and around the eye. One eye is first attacked, followed by the other, at an interval from a few weeks to months. The eye first affected recovers first. The disease lasts from six months to two years.

Results.—The eye may completely recover, but often the cornea is permanently damaged by loss of transparency. When the cornea has ulcerated or sloughed a leucoma will remain.

Treatment.—A nutritious diet, fresh raw arterial bullock's blood being of great service. Keep the bowels open with calomel and rhubarb and magnesia. Give a mixture containing acetate of ammonia and vin. antimon. This should be followed by liq. hydrarg. perchlor. with tr. ferri perchlor. Dover's powder is

useful at night. In strumous children, ol. morrhuae, syr. ferri phosph. co., or syr. ferri iodi. Change of air, counter-irritants by small blisters to the temple, or tr. iodi. painted on the lids.

Local.—All local applications in affections of the cornea must be of a *soothing character*, and no irritant is admissible. Protect the eye from light by neutral glasses. Atropine and cocaine are the best agents to use to the eye. Belladonna and glycerine may be smeared over the brow. If the turbidity be approaching the pupil, an iridectomy should be performed on the side whence the turbidity is chiefly spreading.

Syphilitic Keratitis or Diffuse Interstitial Corneitis occurs in individuals who are affected with hereditary syphilis, from five to eighteen years of age, being generally the last symptom of this condition which presents itself. As a very rare event it may occur in acquired syphilis during the secondary stage (Hutchinson).

Symptoms.—1. Infiltration. The disease begins at the centre of one cornea as a diffused haziness. Soon white dots appear in the substance of the corneal tissue; these coalesce, and finally most of the cornea becomes opaque, except a band near its margin. 2. Vascularisation. The sclerotic zone becomes visible in three to six weeks, and new vessels are seen projecting into the substance of the cornea, which assumes a pink hue. This is a favourable symptom. This stage lasts from three to six months, and is followed by: 3. Resolution. The vessels become smaller, and clear patches of cornea appear.

The upper central incisors of the permanent teeth are notched and peg-shaped, and deafness often coexists. Some intolerance of light and supra-orbital pain, together with dimness of sight, are complained of, but there is no tendency to ulceration or pustulation. The second eye is affected from one to three months after the first. The disease lasts from twelve to eighteen months. Iritis will sometimes complicate this affection.

Results.—The cornea may recover perfectly, but often opaque patches remain. In the best cases the eye usually remains somewhat damaged as to vision, and often a degree of abnormal expansion of the cornea is apparent. Iritis and choroiditis may be conjoined.

Treatment.—Protect the eye by neutral glasses. Atropine drops. Mercurial inunction, avoiding salivation, and syr. ferri iodi, or tr. ferri perchlor. in small doses. Perchloride of mercury solution is useful, or hydrarg. c. creta. Nutritious diet and pure air. When the disease is subsiding yellow oxide of mercury ointment will help to clear the cornea.

Phlyctenular Keratitis—Scrofulous or Strumous Ophthalmia.

Causes.—It occurs in children from two years old to puberty. Scrofulous diathesis. Subsequent to measles, scarlet fever, and whooping cough. Reflex irritation. Foreign bodies.

Objective Symptoms.—1. Redness and soreness of the cheek. 2. Lachrymation. 3. A small herpetic whitish elevation (phlyctenula) on the cornea, or an ulcer. 4. A leash of vessels running from the margin of the cornea to the phlyctenula. 5. Cornea is hazy. 6. Spasm of the orbicularis (blepharospasm). 7. Sclerotic zone.

Subjective Symptoms.—1. Great intolerance of light. 2. Severe pain.

There are three other forms: 1. Milia, phlyctenulae being scattered round the entire margin of the cornea; 2. Pustular, with large phlyctenulae round the corneal margin, resulting in death of the part affected, and creeping ulcer; 3. Diffused, the phlyctenulae forming from time to time on the surface of the cornea, leading to haziness and pannus.

Often there are eczema, impetigo, sores about the nose and lips, enlarged glands, etc. The disease is slow to cure and apt to relapse.

Diagnosis.—This is made by the presence of the phlyctenulae, leash of vessels, and great intolerance of light.

Results.—Resolution. Ulceration of the cornea, followed by protrusion of the iris. Infiltration of the cornea. Entropion. Tinea tarsi.

Treatment.—Protect the eyes with neutral glasses. Fresh air and nutritious diet, including fresh raw bullock's blood. Vin. antimon. (m^x to xx every four hours). If this fail, hydrarg. c. creta gr. j, with extract of hyoscyamus gr. ss, until feverishness have disappeared; then tr. ferri perchlor. in small doses, or quinine. Syr. ferri iod. or syr. ferri phosph. co., or syr. ferri hyperphosph. Ol. morrhuae. If eczema be present, liq. arsenicalis. The bowels should be kept

open with calomel and rhubarb or scammony. Pulv. ipecac. co. at night if there be restlessness.

Local.—Sulphate of eserine (gr. ij to ʒj) π j dropped into eye twice a day. To examine the eye, it is often necessary to administer an anæsthetic, when, by the use of a speculum and fixation forceps, a clear view of the cornea can be obtained. Cocaine in solution or disc should be inserted between the lids, and the pustules touched with solid nitrate of silver. Pagenstecher's ointment (hydrarg. peroxid. precip. gr. xxx, vaseline ʒj) is of the utmost service; a piece the size of a pea should be applied daily. When there is much photophobia, give the child an anæsthetic, and divide the external canthus horizontally to the margin of the orbit with the knife or scissors, apply compresses of cold water, and keep in a dark room for twenty-four hours. Steaming the eye with the vapour of hot water, and chloroform vapour. Alkaline lotions containing hydrocyanic acid are useful. Small blisters to the temple, or tr. iodi. to the eyelids. A seton in the hairy scalp for some months. Olive oil smeared at night along the lids. The eyes must not be bandaged. If there be eczema of the lids, boracic lotion.

Suppurative Keratitis.—*Causes.* Contused or lacerated wounds of the cornea. Unhealthy constitutions, especially the aged and ill-fed. Disease or injury of the fifth nerve. As a rare sequence of phlyctenular keratitis.

Symptoms.—The cornea is dull and hazy, inflammatory exudation occurs among the lamellæ, followed by suppuration. This begins at a little below the centre as a yellowish spot, increases, and spreads itself through the structure and cornea, concealing the iris. The eye is painful and hot. Severe neuralgic pains. Congestion of the sclerotic and conjunctival vessels. Photophobia. Lachrymation. The cornea softens and gives way, either anteriorly, leading to prolapse of the iris and loss of vision, or posteriorly into the anterior chambers, where the pus sinks to the bottom, forming a *hypopyon*. When the suppuration is limited, only involving the lower part of the cornea, and confined within the laminae, it is termed *onyx*. When the suppuration is more diffused, the name *abscess of the cornea* is applied.

Results.—If the whole cornea be affected, loss of the eye; if limited, a leucoma will follow.

Treatment.—Liberal diet, with stimulants. Ammonia, and bark or quinine. Opiates or subcutaneous injection of morphia to relieve pain. Chloroform liniment applied to the painful spots of the temple or brow is useful.—*Local:* In traumatic cases, open up the wound with a spatula, evacuate the aqueous and wash out the anterior chamber with a solution of boracic acid or a 5 per cent. solution of salicylic acid at intervals of every eight hours; the conjunctiva should be washed with the same. In severe cases the wound should be touched with the galvanic cautery. In non-traumatic cases, the most important point is the application of Eserine drops (neutral sulphate of eserine gr. ij—iv to ʒj). If the outer layers of the cornea be broken, sulphate of quinine is a good lotion. Warm fomentations and hot compresses are serviceable. When pus is effused between the corneal laminae Sämisch's operation, which consists in making an incision through the ulcer or abscess, with a Graefe's knife, including some healthy cornea on each side, and opening the anterior chamber. This is kept patent by passing a probe daily. In cases of hypopyon with increased tension, iridectomy or a paracentesis of the cornea. A 2 per cent. solution of cocaine applied to the eye will in about a quarter of an hour secure the necessary anæsthesia for operations on the cornea. Cocaine produces: 1. Anæsthesia of the cornea and conjunctiva; 2. Mydriasis; 3. Paralysis of accommodation; 4. Enlargement of the palpebral aperture, with retraction of the upper lid; 5. Paleness of the eyeball and contraction of the peripheral vessels. Its action is through the sympathetic.

Paracentesis of the Cornea.—A broad cutting needle is made to puncture the cornea at its lower border, and the point is kept forward until the anterior chamber be opened, when the knife is turned on its axis to make the opening wide, and the fluid is allowed to run off. The knife is then again turned on the flat and withdrawn.

Ulcers of the Cornea may result from inflammation of the conjunctiva or cornea, but often occur spontaneously in persons who are debilitated or in bad

health. They may be traumatic. Ulcers of the cornea are divided into superficial and deep.

Superficial Ulcers include: 1. The Absorption or Nebulous; 2. Transparent or Superficial Non-vascular. The symptoms are photophobia, lachrymation, and redness of the eye on exposure to light. The *nebulous* ulcer is met with on any part of the cornea; it is irregular, small, and ill-defined; the edges slightly raised and greyish-looking, the centre more transparent. It remains stationary for some time, and then begins to heal. The *transparent* ulcer looks as if a piece of the cornea had been punched out at one or more points. It is glistening and transparent, most frequently situated near the corneal margin, and is most common in children. The superficial ulcers become opaque when healing, and have a cloudy halo round them, with one or more red vessels running from the margin of the cornea. Sometimes the ulcer remains vascular, the granulation tissue failing to cicatrise; it then forms the *Irritable Vascular Ulcer*, which is exceedingly painful and sensitive.

Treatment.—The cornea may be anæsthetised with cocaine and the ulcer scraped, treated with a strong solution of nitrate of silver (gr. x—xx to ʒj), or by the galvanic cautery. Then apply eserine drops. In children, hyd. c. creta every second night, or mist. antimon. tart. if there be feverishness. Afterwards, iron, bark, or cod-liver oil.

Deep Ulcers.—Three forms are met with: 1. Sloughing; 2. Infecting Ulcers; 3. Crescentic. The *sloughing* occurs in persons who are weak and badly nourished, and as a result of suppurative corneitis. It is irregular, with ill-defined sloping edges, and a whitish yellow sloughing base. The *infecting ulcer* (Sämisch's ulcer) is a severe form which spreads by infection, invading the cornea in all directions, and converting it into a slough. The edges are swollen and irregular; base greyish; aqueous profuse, turbid, and purulent; anterior chamber deep; pain is slight at first, then excessive, until perforation, which is a usual sequence, occurs. It most commonly results from slight injuries and inoculation of septic matter; it is most frequent after forty, and in debilitated subjects. The *crescentic* occurs at the edge of the cornea, forming a crescentic groove which extends rapidly in

length and depth. It has a transparent floor with sharply defined edges. The deep ulcers are apt to end in perforation of the cornea with prolapse of the iris; or may stop short at the posterior elastic layer of the cornea, which is pushed forward, forming a hernia corneæ. If these ulcers heal, an opaque cicatricial tissue is formed (leucoma).

Treatment of sloughing ulcers is the same as for suppurative keratitis. For infecting ulcers, Sämisch's operation, warm fomentations, and the antiseptic application of perchloride of mercury, quinine, etc. For the crescentic ulcer, the eyes must be shaded from light, and the eyelids kept shut by plaster. Liberal diet with stimulants and tonics. Opiates to relieve pain. As local applications, scraping the edges of the ulcer with a small lupus scoop is a useful measure; solid nitrate of silver; actual cautery. Iodoform and hydrarg. oxid. flav. gr. ij to vaseline ʒj is a capital stimulant ointment. Eserine drops are necessary. Iridectomy, or Sämisch's operation. Seton in the back of the neck.

Opacities of the Cornea.—*Causes.* Inflammation of the cornea resulting from disease or injury, producing interstitial deposition or cicatrization.

Symptoms.—Opacities are divided into nebula, albugo, and leucoma.

A *Nebula* is a slight semi-transparent opacity with the edge gradually shading into the surrounding tissue. It may be limited to a part of the cornea, or be generally diffused.

An *Albugo* is a more severe opacity with a border which shades off, but an opaque white centre.

A *Leucoma* is a dense white cicatrix of the cornea occurring after loss of substance. If prolapsus iridis have occurred through a corneal ulcer, the iris appears as a black spot in the centre of a leucoma. The curvature of the eye may be altered and the latter rendered astigmatic by a leucoma.

Prognosis.—As regards a nebula, if only existing for a short time, with the presence of a sclerotic zone, and irritability of the eye, it may disappear under treatment; but if it have lasted a long period with no signs of inflammation, it cannot be removed. In infants and young persons, even a dense leucoma will diminish and become more transparent.

Treatment.—For nebula, drops of bi-

chloride of mercury; oil of turpentine and olive oil (1 to 7). Lotions of sulphate of zinc or chloride of zinc. Iodide of potassium by the mouth. Powders dusted into the eye, as calomel or sulphate of soda. Ointments, as red precipitate, or ung. hydrarg. nit. A leucoma is irremediable, but if unsightly, can be tattooed; should it occlude a portion of the pupil an artificial pupil must be made. Wolfe has successfully transplanted the cornea from a recently extirpated eye in a case of leucoma. He says: "The cornea can maintain its vitality and transparency when transferred from one place to another, but must be taken from a freshly enucleated human eye. The incisions must be clean, and the measurement exact. He does not remove the whole cornea, but a strip from the middle, including also a strip of conjunctiva on each side.

Other diseases of the cornea are conical cornea and staphyloma.

Conical Cornea, or Keratoconus, consists in a bulging of the middle portion of the cornea, so that instead of forming a segment of a sphere it presents a conical shape. It affects persons from twenty to thirty, especially women. The cause is unknown, but Tweedy considers it to be due to congenital imperfection in development of the centre of the cornea. It is best recognised by the peculiar appearance of a bright drop resembling fluid in the centre of the cornea when seen from the front, and change of shape when looked at in profile. It progresses slowly and without pain. The patient becomes myopic and irregularly astigmatic, vision becoming indistinct at any distance, and is not much improved by any lens. By retinoscopy, or the shadow test, there is seen a bright central reflex surrounded by a crescentic shadow which moves round the centre as the mirror is rotated, but never crosses it. By the ophthalmoscope the vessels of the optic disc and the disc itself appear to be distorted and to alter in size and shape with movements of the observer's head.

Treatment.—Avoid straining the eye. Eserine drops. Compresses of lint applied to each eye alternately. Improve the general health and regulate the menstrual functions. The use of a stenopaic slit will sometimes benefit near vision. Small and continued doses of arsenic.

Operative.—1. Removal of the apex of the cone by either excising a small oval piece of the cone of the cornea by means of a Græfe's cataract knife (Bader), or by removal of a circular piece with a trephine (Bowman). If possible the anterior chamber should not be opened. A central leucoma results, and then an artificial pupil is made by a subsequent operation; the leucoma can finally be tattooed and appropriate glasses worn.

2. Multiple punctures of the apex of the cone with a fine cataract needle (Tweedy). The summit of the cone is transfixated from three to six times at each sitting, which may be repeated at intervals of two weeks or more. The eye is supported with a compress and bandage. The pupil kept under the influence of eserine. A network of cicatricial tissue results, which flattens the cone without giving rise to much opacity.

3. Actual cautery (Andrew). Cocaine is used, and the pupil well dilated with atropine. With a very fine needle cautery, highly heated, a minute opening is made through the apex of the cone. Directly the cautery has penetrated the cornea, known by the hissing sound produced by the aqueous, it is removed. The lids are closed, and not opened for three days; a little castor oil and atropine is placed on the lashes every morning, and a pad is applied.

Staphyloma of the Cornea is a bulging of the whole or a portion of a cicatrix of the cornea, occurring after sloughing or ulceration. If complete, the iris is adherent to the cicatrix.

Treatment.—Of partial staphyloma. Iridectomy is useful both in preventing an extension of the staphyloma and in removing the pupil opposite to a clear part of the cornea. Trephining the apex is also sometimes of service.—Of complete staphyloma. Remove the lens if a cornea have sloughed, to prevent staphyloma. If staphyloma have formed, but be recent, it may be punctured with a broad needle, and the lens removed with a curette. When the staphyloma is of some standing it must be removed, and this is best done by Mules' operation, clearing out the contents of the sclerotic and inserting a glass ball, which will retain, for an artificial eye, the power of moving.

Injuries of the Cornea.—Foreign bodies may be embedded in the cornea. Symp-

toms are, irritability of the affected eye with lachrymation, spasmodic closure of the lid with a feeling of grittiness.

Treatment.—Place the patient opposite a good light, and use a cocaine disc or a 2 per cent. solution of cocaine to procure local anæsthesia, evert the lower lid and examine the cornea with oblique illumination; if the foreign body be seen, remove it; if not, evert the upper lid and remove it. If the foreign body have not penetrated deeply, remove it with a spud or broad needle. If the substance have deeply penetrated, use eserine drops and then introduce a broad needle into the substance of the cornea by the side of the foreign body, pass this needle behind it, thus giving a firm support, then remove the foreign body with another needle. Should the substance be lying close to the anterior chamber, one broad needle is to be passed into the anterior chamber and fixed behind the substance, whilst with another the cornea is scraped through until the foreign body be reached. The after-treatment consists in olive or castor-oil drops, protection from light, and atropine or belladonna lotion; if necessary, leeches may be applied. If the foreign body be forced into the anterior chamber, make an incision through the cornea and remove the foreign body with forceps, performing iridectomy if necessary. When the foreign body consists of iron or steel, use the electro-magnet to withdraw it. Should a foreign body remain, very great irritation ensues, keratitis arises, the epithelium of the cornea becomes white and swollen, and the foreign body is loosened. The keratitis subsides when the substance is removed, but is sometimes obstinate, and a nebula is often left. A particle of iron or steel often leaves a rust mark in the form of a ring with a clear centre, but this usually soon disappears.

Abrasions of the Cornea result from direct injury, as the scratch of a nail, or in reapers from the stroke of an ear of corn, or from laceration with an infant's finger nail, etc.

Symptoms.—Pain, photophobia, great lachrymation, injection of the conjunctiva, and a feeling of something in the eye. On examination with oblique illumination and a good light the abrasion will be seen as a shining spot. In healthy persons this is easily recovered from, but in delicate individuals diffuse suppurative

keratitis with loss of the eye may follow.

Treatment.—Castor oil dropped in the eye every hour. Protect the eye from light with a pad or bandage. Atropine discs or drops. Belladonna fomentations and leeches if the eye be painful. Opiates. If suppurative inflammation occur it must be treated as before directed.

Punctured and Incised Wounds.—Simple incised wounds of the cornea, as made in operations, generally heal quickly. Accidental wounds if complicated with contusion, etc., may be followed by severe inflammation. Penetrating wounds of the cornea are followed by escape of the aqueous humour, with frequently protrusion of the iris.

Treatment.—If prolapse of the iris be recent and slight, the upper eyelid may be rubbed over the cornea, and then raised suddenly, exposing the eye to a bright light, when the pupil may contract and relieve the iris. Or drops of atropine or eserine may have a like effect. Careful pressure with a probe or flat spatula may be tried. When the iris cannot be reduced or retained it should be excised. If the prolapse be more than a week old, should it be extensive and marginal, repeated punctures with a fine needle will allow the aqueous to escape and the corneal wound to close. If the protruded iris cannot be returned it may be touched with nitrate of silver. Should adhesion drag on the pupil, it is best to make an iridectomy in the opposite direction.—General: Protect the eye from light by compresses and shades for fourteen or twenty-one days, and afterwards spectacles. Apply leeches. Keep the pupil dilated with atropine, and treat any iritis or keratitis which may supervene.

Scleritis, or Episcleritis, consists in inflammation of the episclera or capsule of Tenon (the loose fibrous covering of the sclerotic), together with some amount of inflammation of the sclerotic, and maybe the conjunctiva.

Causes.—It occurs in rheumatic individuals, and occasionally in struma or syphilis. One form is common in anæmic and debilitated women, and is associated with uterine derangements, pregnancy, etc.

Symptoms.—1. A dusky red spot or spots close to the corneal margin or over the insertion of one of the recti tendons. The redness is under the conjunctiva, and

is only slightly elevated. 2. If the red patch be very close to the cornea the latter may become opaque (sclerotising opacity). 3. The pain may be slight, of an aching character, but in some cases, especially if there be complications, is paroxysmal and circumorbital. The course of the disease is very chronic, the symptoms being apt to recur. As a rare event, thinning of the sclerotic may result, with the formation of staphyloma.

Complications.—Keratitis, phlyctenular ophthalmia, iritis, and irido-choroiditis.

Treatment.—Atropine drops. Warm fomentations and the eye protected from light. Belladonna and glycerine to the brow or temple. In chronic cases, blisters to the temple and compresses to the closed lids.—Internally: Salicylate of soda; quinine and calomel; iodide of potassium. If syphilis be suspected, give mercury. In strumous cases, cod-liver oil, maltine, etc. In obstinate cases, excite profuse diaphoresis by the hypodermic injection of pilocarpine, hot baths, Turkish baths, etc. If keratitis be present, sclerotomy is useful.

Cyclitis, or Inflammation of the Ciliary Body.—*Causes.* Injuries, as penetrating wounds in the dangerous region which extends one-third of an inch round the cornea; dislocation of the lens; foreign bodies or any mechanical injury. Secondary to inflammation of the choroid and iris. In debilitated persons suffering from anæmia, uterine complaints, overwork, etc. The disease has a great tendency to recur, and generally affects one part more than another.

Symptoms.—1. Pain and tenderness on pressure over the ciliary region. 2. Sclerotic zone. 3. Increased tension. 4. Turbidity of the vitreous. 5. Photophobia and lachrymation. 6. Impairment of vision. 7. Iritis is generally conjoined, and hypopyon, with turbidity of the aqueous, and deepness of the anterior chamber.

Sequelæ.—Glaucoma; sympathetic ophthalmia; disease of the iris, choroid, retina; and cataract.

Treatment.—Leeches to the temple. Belladonna fomentations. Opiates to relieve the pain. Liberal diet; attention to the bowels; quinine or bark. When caused by injury, if it be not soon subdued, extirpation of the eye must be performed to save the other eye from sympathetic

inflammation. Should the disease occur in debilitated subjects, give tonics, and in women, attend to the uterine functions. When tension is increased, perform iridectomy.

Injuries of the Sclerotic.—Simple incised wounds heal readily. Perforating wounds are generally complicated with injury or protrusion of the iris, ciliary body, choroid, retina, vitreous, lens, its capsule or suspensory ligament; another complication is the lodgment of a foreign body; thirdly, intraocular hæmorrhage is of frequent occurrence. There is great risk, especially if the wound be in the ciliary region, of sympathetic ophthalmia. If the force producing the wound be great and the instrument blunt, the symptoms arising from concussion of the eyeball will be present, as sub-conjunctival hæmorrhage, paralysis of one or more of the recti, implication of the iris, choroid, retina; detachment or laceration of the capsule of the lens; hæmorrhage into the anterior chamber or vitreous, etc.; concussion or laceration of the optic nerve, etc. These wounds are apt to gape, and this is best prevented by a very fine silk suture passed from within outwards. Wounds of the sclerotic are treated in a similar manner to corneal wound; of course, if the injury be so severe that the eye is hopelessly damaged for all purposes of vision, evisceration by Mules' method is advisable.

Rupture of the Sclerotic is a very serious injury following blows on the eye, etc. The rupture which occurs on the side opposite to that on which the violence is applied, is situated close to the margin of the cornea at the upper and inner part of the globe. There may be protrusion or detachment of the iris, dislocation of the lens, intraocular hæmorrhage, escape of vitreous, etc.

Treatment.—Rest to the eye, which should be kept closed by a pad and bandage. Two or three leeches when there is pain. If the eye have lost perception of light at the end of a fortnight, extirpation is to be recommended. When there is subconjunctival dislocation of the lens, unless the latter be lodged in the margins of the wound, it is better not to remove it until the sclerotic wound be healed.

Iritis, or Inflammation of the Iris.—*Causes.* Primary iritis is due to syphilis, rheumatism, gout, exposure to

cold, or injury. Secondary iritis accompanies inflammation of the tissues in the vicinity, as the cornea, choroid, etc. Iritis is most common in youth and middle age.

Symptoms.—1. The iris loses its brilliancy, changes its colour to that of a yellowish red, blended with the original colour; a blue iris becoming green; a brown, reddish brown. It appears mnddy, and is deprived of its striation. Lymph is effused on the anterior or posterior surfaces, or in its substance. 2. Pupil is contracted and the movements sluggish. 3. The lymph effused adheres to the capsule of the lens (posterior synechia), or to the cornea (anterior synechia), or all round the margin (complete synechia). 4. The sclerotic zone is well marked. 5. The conjunctiva is more or less injected. 6. The aqueous is increased and serous, whilst flakes of lymph impart a turbidity. 7. Dimness of vision. 8. Feeling of distension in the eyeball. Severe paroxysmal pain, circumorbital or temporal, and increased in severity at night. Dull pain extending from the forehead to the back of the head. 9. Intolerance of light, and lachrymation. 10. Fever.

Treatment.—1. Keep the pupil fully dilated by atropine. 2. Ease pain by opiates, etc. 3. Promote absorption by mercury, which may be combined with opium.

Special Forms of Iritis.—1. Syphilitic iritis is a secondary symptom, and generally attacks both eyes, but successively. There are the general symptoms of iritis, but these are often insidious in their origin, and adhesions alone may first call attention to this affection. The great characteristic symptom is rapid effusion of lymph on the face of the iris, especially towards the inner or outer borders, in the form of yellow, reddish, or reddish brown nodules. When once cured the disease is not liable to recur. Sometimes it spreads to the choroid, retina, or vitreous body. Syphilitic iritis is also met with in congenital syphilis. According to Hutchinson it is more frequent in the female, occurs at or about five months, is often bilateral, is seldom complicated, and attended by but few of the more severe symptoms which occur in the adult. The effusion of

lymph is very free, and the danger of pupil occlusion great. Most of those who suffer are infants born within a short period of the date of the primary disease in their parents.

Treatment.—In adults, calomel gr. ij with opium gr. j night and morning, until the gums be affected, when the dose should be diminished. Inunction with ung. hydrarg. is sometimes preferable. Quinine and good food in debilitated persons. Afterwards, iodide of potassium and iron. When the case is chronic, perchloride of mercury and iodide of potassium. When mercury cannot be used, turpentine or balsam copaibæ in drachm doses three times a day. Locally: Atropine drops (gr. ij to 3j), or atropine discs, applied three times a day, and belladonna lotion (ext. belladonn. gr. ʒ, aq. ad 3j). If there be much congestion a leech is useful. When there is much pain, cocaine discs will often relieve it; if this fail, perform paracentesis of the cornea, and should it still continue, iridectomy is advisable, a measure which should also be adopted if permanent adhesions remain. Blisters are useful in the chronic form. It is important to guard the eye from light, and only to use the other for locomotive purposes, and not for reading or fine work.

2. *Rheumatic Iritis.*—In this form the iritis is plastic, but lymph is effused in a smaller quantity than in the syphilitic form. There is more pain and intolerance of light, and the iris is less swollen and muddy than in the preceding variety. Repeated recurrences are common. Inflammatory fever is well marked. The cornea may be hazy, and the sclerotic injected and of a purplish colour. Gonorrhœal rheumatism may be followed by a rheumatic iritis.

3. *Gouty Iritis*, occurring in the children of gouty parents, has been described by Jonathan Hutchinson. It occurs at an early age, and is insidious, painless, and persistent; without any attack of acute inflammation, adhesions quickly form between the iris and the capsule of the lens. The pupil becomes excluded, then occluded, and lastly, effusion behind the iris completes the disorganisation of the eye. It attacks one eye first, advancing to almost total loss of sight; then the other. It is very intractable.

Treatment of Rheumatic and Gouty Iritis.—Leeches at the commencement in strong persons. Mercury in small doses, combined with Dover's powder and tartar emetic, must be given to prevent or limit lymph exudation. Quinine or bark should be administered at the same time. Salicylate of soda or iodide of potassium, with bicarbonate of soda, is often useful. Colchicum occasionally is of service. Hypodermic injections of morphia to relieve pain, or opium (gr. j in pill), or cocaine discs. In obstinate cases, turpentine, or Chian turpentine, and blisters.—Locally: Atropine drops and belladonna lotion. If atropine disagree, duboisin may be used in the form of the neutral sulphate (gr. i—iv to 5j).

4. *Serous Iritis — Aquo-Capsulitis — Kerato-Iritis, or Keratitis Punctata.*

Causes.—Rheumatism, congenital syphilis, disordered menstrual functions, renal disease, and sympathetic ophthalmia.

The disease is insidious and chronic, with but little tendency to plastic exudation.

Symptoms.—1. The cornea is diffusely hazy, and the seat of opacities, due to the deposit of some material upon the membrane of Descemet; these take the form of brownish dots arranged pyramidally with the apex upwards towards the pupil, and varying from the size of a pin's head upwards, the smaller being at the apex. When looked at by focal illumination the dots appear of a greyish colour.

2. Increased secretion of serous and turbid aqueous, with abnormal depth of the anterior chamber. Increased tension.

3. The pupil is sluggish and slightly dilated. The iris is pushed backwards and is concave in front. Total posterior synechia. Increased ciliary redness.

Subjective.—1. Dimness of sight. 2. Distension and fulness of the eyeball. 3. Pain of a dull aching character in the forehead or back of head.

Treatment.—Iodide of potassium and iron. Quinine. Subcutaneous injections of pilocarpine. Turpentine in 5j doses, or Chian turpentine gr. v om. 3 h. In children, syr. ferr. phosph. co., or syr. ferr. iodid. with hydrarg. c. creta.—Locally: Atropine drops and belladonna lotion;

leeches; hot fomentations. If there be much tension, eserine drops and paracentesis corneæ.

5. *Traumatic Iritis* follows a wound of the iris, lens, or both. When the lens is swollen it presses on the back of the iris and acts as a source of irritation. Traumatic iritis may be acute or chronic. The acute form supervenes four or five days after the injury, with chemosis of the conjunctiva and oedema of the lids. There may be effusion of lymph on the surface of the iris and in the pupil. In other cases suppurative iritis results, with rapid exudation, filling the pupil. The iris is hazy, and the surface covered with puro-lymph; hypopyon is present; the cornea becomes hazy, ulcerates, and pus is effused in its substance, forming onyx, followed by perforation.

Results.—Resolution, with more or less synechia; chronic iritis; implication of the choroid and retina.

The *chronic form* commences, one or two weeks after the injury, with photophobia and lachrymation. The aqueous is serous, striæ of the iris indistinct, pupil sluggish with dull pain in the eye.

Treatment.—Lint dipped in ice-cold water. Atropine drops and belladonna lotions. Leeches to the neighbourhood of the eye. A saline purgative, followed by the mineral acids and bark. When chronic, mercurial inunction, and if the tension be increased, iridectomy. If suppurative, warm fomentations and paracentesis corneæ, or iridectomy.

Mydriasis, or Preternatural Dilatation of the Pupil.—*Causes.* *Intra-Ocular.*—Glaucoma, diseases of the retina and choroid, injury to the ciliary nerves.

Extra-Ocular.—Paralysis of the whole of the third nerve, or that branch going to the lenticular ganglion. Disease of the optic nerve outside the eye. Cerebral tumours. Hyperæmia of the cervical portion of the cord. Spinal meningitis. New growths in the cervical portion of the cord. In insanity.

Reflex Causes.—Acting through the sympathetic, and producing spasmodic contraction of the dilating fibres of the iris without the circular fibres being paralysed, as from blows on the head, gastric irritation, worms, rheumatism, etc. In order to see that a case of mydriasis is unaccompanied with affection of the retina, the patient is made to

look through a pin hole in a card which has a blackened surface next the eye, and if the retina be unaffected he will be able to see clearly.

Mydriatic Drugs.—Belladonna, atropine, homatropine, duboisia, duboisin, hyoseyamus, hyoscyamine, stramonium, etc. These act by stimulating the sympathetic, and paralysing the third nerve.

Myosis, or Preternatural Contraction of the Pupil. Causes.—Habitual contraction of the pupil in accommodation for near vision, as in jewellers, watch-makers, engravers, etc. Affection of the sympathetic, as in diseases of the upper part of the spinal cord which communicates with the cervical ganglia. Pressure on the cervical sympathetic by tumours. General paralysis of the insane. In the early stages of simple, tubercular, and cerebro-spinal meningitis. Cerebral apoplexy. Intracranial tumours at the origin or course of the third nerve. At the commencement of hysterical or epileptic attacks. In tobacco amblyopia. Opium poisoning. Calabar bean, or its active principle, eserine, produces myosis, also pilocarpine, muscarin, and nicotine. Inequality in the size of the pupils, the *smaller one being the fixed one*, is the cardinal symptom of paralysis of the sympathetic (Hutchinson).

Operations on the Iris.

Artificial Pupil is an opening made in the iris to serve as a pupil in cases where the natural pupil is covered by a central leucoma, or there is complete posterior synechia, or occlusion of the pupil, and lastly, in central lamellar cataract, to bring the pupil opposite a clear part of the lens. The patient must have a clear perception of light, and be able to distinguish the shadow of the hand between the eye and the light at a distance of two feet; and lastly, there must be no inflammation present.

There are three methods of operating: 1. Incision; 2. Ligature; 3. Excision.

The Operation by Incision—Iridotomy—can only be performed when the iris retains its contractile power and is not adherent to the cornea or lens. It is practically limited to cases of prolapsus iridis, producing occlusion of the pupil after cataract operations.

Operation.—A 4 per cent. solution of cocaine will secure anæsthesia in operation on the iris. The best situation for

artificial pupil is as near the centre as possible, at the lower and inner part of the iris, next in the lower and outer. The eye being anæsthetised is steadied with a wire speculum and fixation forceps. A narrow-bladed knife or cutting needle with its edge backwards is introduced through the sclerotic $\frac{3}{10}$ ths of an inch from the temporal margin of the cornea in the transverse diameter, perpendicular for $\frac{1}{3}$ th of an inch, then inclined greatly backwards towards the temple and made to pierce the iris from behind, $\frac{1}{10}$ th of an inch from the temporal border. By inclining the handle, the edge of the knife is brought against the iris and made to cut it during withdrawal.

Modifications.—Bowman punctures the cornea midway between the centre and external border, passes a narrow, blunt-pointed knife through the puncture and through the pupil to the posterior surface of the inner half of the iris, which is divided by cutting forwards. Other surgeons prefer puncturing the cornea close to its edge, passing the knife as far as the middle of the iris, and dividing this from before backwards. Instead of a knife Wilde's canula-scissors are sometimes used to divide the iris, especially in cases where the iris cannot contract, cutting with two incisions a triangular flap.

2. *Operation by Ligature.*—*Iridodesis* (Critchett).—This operation gives a regular pupil of a size in accordance with the operator's will, and does not cause bleeding into the anterior chamber, but is liable to be followed by chronic iritis. It is used in cases of central lamellar cataract, central opacity of the cornea, conical cornea, and narrowing of the pupil with synechia.

Operation.—The eye being anæsthetised, and fixed with a speculum and forceps, the cornea is punctured with a broad needle at that part of its margin where the pupil is to be placed. A sufficiently large opening having been made, a loop of fine silk is laid over the wound. Through this loop the canula-forceps is introduced, and a portion of iris seized midway between its borders, and drawn out through the wound. An assistant seizes each end of the ligature with cilia forceps, and ties it close to the cornea, strangulating the prolapsed portion of iris. The ends of the ligature

are cut off, the eye closed, and both eyes bandaged. The knot drops off in a day or two, and the iris has meanwhile become adherent to the cornea. If the pupil have to extend to the border of the iris the margin must be seized by the forceps, or an iris hook can be used.

3. *Excision.*—*Iridectomy.*—Instruments required: 1. Anæsthetic, or 4 per cent. solution of cocaine; 2. Speculum; 3. Toothed forceps; 4. Iridectomy knives, or Sichel's cataract knife; 5. Iris forceps; 6. Iris hook; 7. Capsule seissors; 8. Light curved seissors; 9. Lint or absorbent cotton; 10. Compress and bandage; 11. Atropine drops; 12. Small sponge and basin; 13. Hot and cold water.

Iridectomy is employed to make an artificial pupil in almost all cases where this measure is necessary, and is then termed optical iridectomy: it is also used to relieve increased tension, as in glaucoma and irido-choroiditis, when it is called antiphlogistic iridectomy.

Antiphlogistic Iridectomy.—In this operation the excision of the iris should be made upwards, so that it will be covered, in some measure, by the upper lid, and as much of the iris as possible should be removed, including the greater circumference. An anæsthetic is administered, or local anæsthesia procured by means of the cocaine solution, and the eye controlled with the speculum and forceps, the latter being applied opposite the point of puncture. A Sichel's cataract knife is introduced perpendicularly to the surface of the sclerotic at its junction with the cornea, or a little outside this, and passed on until it have entered the anterior chamber, when the edge is directed upwards and forwards with a slight vertical to and fro movement, until the incision extend to one-eighth of the circumference. The knife is gradually withdrawn, allowing the evacuation of the aqueous humour. The curved iridectomy forceps is introduced closed, as far as the margin of the pupil, which is seized and drawn out. An assistant makes a vertical cut with seissors right up to the margin of the iris, then the operator tears the part held by the forceps from its attachment, as far as the other extremity of the wound, and removes it by another vertical cut. If there be bleeding into the anterior chamber the edges of the wound should be separated with a

curette, and gentle pressure made on the eyeball.

Modification.—Many surgeons use a lance-shaped iridectomy knife to make the incision, and instead of iridectomy forceps a Tyrrell's hook, introduced on its side, turned downwards when it reaches the pupil, and withdrawn, along with the portion of iris, with the hooked part looking forwards.

Optical Iridectomy is performed in a similar manner, but a small central portion only of the iris is to be removed. A broad needle is used to make the incision, which is confined to the cornea, and Tyrrell's hook is used to seize and draw out the iris. If the edge of the iris be adherent, the operation of corelysis may be performed previously, or the canula-forceps may be introduced and the iris seized. In this case the artificial pupil is smaller than in the previous operation, and made as near the centre as possible, never being placed upwards if this can be avoided.

Corelysis, or Streatfeild's Operation, for rupture of adhesions uniting the margin of the pupil and the lens. The eye is fixed as usual, a puncture is made in the cornea on the side opposite the adhesion, and Streatfeild's spatula-hook introduced through the pupil, the adhesion separated with its spatula edge, and if this cannot be done, torn through with the hook. When the adhesions are too strong, canula-seissors are used to cut them.

Irido-Choroiditis, or inflammation, affecting primarily the iris, and secondarily the choroid.

Causes.—Recurrent iritis, with complete posterior synechia, producing exclusion of the pupil, with accumulation of the aqueous in the posterior chamber.

Symptoms.—Those of recurrent iritis with effusion of lymph in the pupil, covering the lens. Bulging of the iris by the aqueous, rendering the surface convex and irregularly knotty. Striation indistinct. Opacities and cloudiness of the vitreous. Vision is impaired. Tension is increased at the beginning, but diminished below the normal at a more advanced state.

Treatment.—Iridectomy and the general treatment for iritis.

Choroido-Iritis is inflammation, primarily in the choroid, secondarily in the iris.

Symptoms.—1. Diminished vision. 2. Dilated and sluggish pupil. 3. Cloudy vitreous. These are followed by a gradual and subacute iritis. The field of vision becomes more contracted, and at parts lost, from detachment of the retina and atrophy of the choroid. The tension is lessened as the disease advances.

Treatment.—The same as that for syphilitic retinitis.

Sympathetic Ophthalmia is an inflammation occurring in an eye subsequently to an injury of the opposite eye.

Causes.—Wounds of the eye, especially penetrating and lacerated wounds in the ciliary region; injuries attended with the lodgment of a foreign body in the globe; adhesions of the iris to the margins of a wound; degenerative changes in an eye which has lost its vision from any cause. It is most common and rapid in the young.

Symptoms.—There are two forms: one, consisting in an irritable condition of the uninjured eye, is termed *sympathetic irritation*, and is unaccompanied with plastic effusion; the other, or *sympathetic ophthalmia*, is associated with rapid plastic effusion.

Sympathetic Irritation has the following symptoms.—1. The eye soon becomes fatigued, is easily congested, and lachrymation readily occurs. 2. Vision is, as a rule, normal, but cannot be sustained for any length of time. 3. Accommodative power is sometimes lessened. 4. The field of vision may be contracted. 5. Neuralgic pains may occur in the sound eye. 6. Some intolerance of light.

Sympathetic Ophthalmia has the following symptoms.—1. The eye is soon fatigued, and easily waters. 2. Slight conjunctival redness. 3. Increased sensitiveness to light. 4. Power of accommodation diminished. These are followed by: 5. Sclerotic zone. 6. Iritis, with effusion of the lymph in the substance of the iris; the pupil is soon fixed by adhesions, affecting the whole posterior surface of the iris, to the lens capsule, and cannot be dilated; the striation of the iris is lost. 7. Irido-cyclo-choroiditis subsequently ensues, the lens becoming opaque and covered on its posterior surface with thick exudations from the ciliary body. 8. Pain is at first *absent*, though at a later stage there may be supraorbital pain, and the eye is tender.

There is generally pain on pressure over the ciliary region of the exciting eye. In slighter cases the symptoms are those of serous iritis. Tension is at first increased, but as the disease advances the vitreous atrophies and tension is diminished. This disease is difficult to arrest, and exceedingly apt to recur; it usually manifests itself from six to eight weeks after the injury to the first eye. Von Graefe pointed out that a suppurative inflammation of the injured eye seldom excites sympathetic ophthalmia in the other. Sympathetic irritation is a reflex neurosis through the agency of the ciliary nerves. With regard to sympathetic ophthalmia, the most rational explanation is that this arises from transference of bacteria through the lymph stream accompanying the central vessels of the optic nerve to the apex of the orbit, reaching the brain, and thence being carried with the lymph stream into the intersheath space of the optic nerve.

Treatment of Sympathetic Irritation.—Removal of the exciting eye. Rest the sympathising eye by abstaining from work, a dark room, and by means of dark glasses. Locally, a weak solution of atropine (gr. j to 3j). Internally, quinine and belladonna.

Of Sympathetic Ophthalmia.—If the injured eye be irreparably lost it should be at once extirpated. When the injured eye retains some sight it should not be removed, as eventually it may be the better of the two. Absolute rest in a darkened room for six to eight months is imperative, and when the patient takes exercise he must wear dark neutral glasses. A generous diet is necessary. Pilocarpine, quinine, iron, bark, nux vomica, the mineral acids, and belladonna are the most useful drugs. Inunction of mercury is sometimes of service. If the inflammation be arrested it is generally necessary to perform an iridectomy, and remove the lens at the same time. When there is increased tension sclerotomy is the preferable operation.

Cataract is an opacity of the lens, lens capsule, or both; these varieties are termed lenticular, capsular, and capsulo-lenticular. The consistence of cataracts varies, so that they are divided into soft and hard. Accordingly as the periphery or centre is chiefly implicated, the

cataract is distinguished as *cortical* or *nuclear*.

Causes.—1. In old age (senile cataract). 2. It may be congenital (congenital cataract). 3. From injury (traumatic cataract). 4. Secondary to disease of the iris, choroid, or retina (secondary cataract). 5. From constitutional disease, as in diabetes (diabetic cataract), inherited syphilis, etc. 6. Certain poisons, as ergot.

Soft Cataract occurs from birth to forty years of age. It may be congenital, or the result of injury or disease. The cataract is of a greyish white or milky white colour, the lens may be increased in size, and then is closer to the iris.

Congenital, or Infantile Cataract.—This cataract is present from birth, or occurs in infancy. Congenital cataract is the result of defective nutrition, or intra-uterine inflammation; it is often accompanied by nystagmus or rhythmical involuntary oscillation of the eyeball. The eyes may be below the normal size, and there may be defective intellect.

This cataract may be nuclear or laminar. Nuclear congenital cataract consists in an opaque nucleus, the peripheral portion being transparent.

Pyramidal, or Punctated Cataract, is met with in infancy, but is not congenital. It is due to deposit of lymph on the anterior capsule, as the result of ophthalmia neonatorum, leading to perforation of the cornea. The lens comes in contact with Descemet's membrane, and as it is pushed back, carries a spot of lymph, which may remain attached to the cornea, forming a pyramid with the apex in the pupil. Saline matter is deposited in this lymph from the aqueous humour, and gives it a milky whiteness. This form is stationary.

Laminar Congenital Cataract (lamellar or zonular), though probably congenital, is not usually discovered until childhood. It may follow convulsions. The teeth, especially the first molars, are frequently diseased. This cataract is characterised by more or less opacity of one layer or lamina of the lens. The nucleus remains clear, but is enclosed in the opaque lamina, and the periphery is also of normal translucency. This cataract is often stationary, but finally all the lens may be implicated. In slight opacities the patient may be able to see

for years, though distant vision will be defective and not improved by glasses.

Treatment.—When the cataract is small and central, a small iridectomy will often afford sufficiently good vision through the clear peripheral portion of the lens. The best methods of operation for soft cataract are: (α) Solution; (β) Rectilinear extraction; (γ) Suetion.

Hard Cataract occurs after the age of forty, and commonly commences between fifty and sixty. The lens is harder than natural, but its size is not increased. It results from vascular changes leading to impaired nutrition in the epithelial cells and fibres of the lens. The varieties are: 1. *Striated*, in the form of opaque streaks running from the circumference to the centre, and chiefly affecting the posterior part of the lens. 2. *Nuclear*: in this form the nucleus is opaque, the peripheral part of the lens being clear at first. 3. *Black*, due to the nucleus being of a dark brown mahogany colour; also in cataracts that have been discoloured by cuticular pigment. 4. *Morgagnian cataract* is one in which the cortex has liquefied as the result of fatty degeneration, the lens capsule being filled with a milky fluid, at the lower part of which lies the hard nucleus.

Treatment, by extraction.

Symptoms of Cataract.—1. A brown, amber, straw, or white colour of the pupil. 2. Gradually failing vision, with inability to distinguish type, but the perception of light is not lost. If the opacity be central the patient sees better in a dull light or under the influence of atropine, as the pupil is then dilated. 3. Mobility of the iris unimpaired, and absence of any symptoms of inflammation. No pain.

Course.—The opacity increases until all useful vision be lost, and the other eye will eventually become affected. The duration is uncertain and variable; it may be months or years.

Diagnosis.—The patient should be seated on a chair, and a lamp placed so that its flame is on a level with, but a little in front of, the eye to be examined, and about two feet distant from it. The pupil is dilated with an atropine disc. A convex glass of two inches focal length is used as a condenser, to concentrate the light upon the eye (lateral, oblique, or focal illumination). By searching the margin of the lens, aided by a magnify-

ing glass, the faintest opacities can be detected as white marks on a black background. Using the ophthalmoscopic mirror with a strong convex glass behind it, the opacities appear black as dark lines or spots.

Soft Cataract is distinguished from hard by the period of life of the patient, colour and aspect of the opacity, and the distance of the lens from the iris.

Operations for Cataract.—When one eye is affected with a cataract, the vision of the other being good, no operation is advisable. If vision be lost in one eye and indistinct in the other, an operation may be performed on the worse eye. If a cataract be fully formed in both eyes the two operations should never be performed at the same time. In congenital cataract the operation is to be accomplished before teething commences. A 4 per cent. solution of cocaine, dropped in at intervals of two minutes, for a quarter of an hour, will produce anæsthesia of the parts.

Operations for Soft Cataract.—(a) By Solution, Division, or Discission. Instruments required: 1. Atropine drops or discs; 2. Anæsthetic, or a 4 per cent. solution of cocaine; 3. Speculum; 4. Lacerating needles; 5. Toothed forceps; 6. Absorbent cotton or lint; 7. Cold water; 8. Compress and bandage. This operation depends on the fact that if the lens capsule be freely opened the aqueous humour more or less quickly dissolves the lens substance. It is used in cases of congenital cataract in infants, and in diabetic cataract. There are two ways of operating: 1. Through the cornea; 2. Through the sclerotic.

Division through the Cornea—Keratonyxis.—The pupil must be well dilated with atropine; the eyelids separated by an assistant or with the speculum; and the eye fixed with forceps. A fine spear-shaped needle is used.

1st Step.—The patient lies on his back, and if a child, chloroform is administered. The operator enters the needle close to the sclerotic margin of the cornea, at its outer and lower part, and the point held perpendicularly is made to pierce the cornea, and is then carried forward well into the anterior chamber; the handle is then depressed and the needle carried onward till in contact with the cataract.

2nd Step.—The edge of the needle is

directed against the capsule of the lens, and one or more incisions made in it by using the handle as a lever and working from the centre. In a congenital cataract in an infant the lens substance can also be well broken up; in adults, however, it is well not to do too much at a sitting. The needle is then withdrawn with its blade flat and parallel with the iris.

The operation in children requires to be repeated once or oftener, and in adults at short intervals, provided all redness and irritability of the eye have left, for some months.

Variety.—Two needles are sometimes used.

After-treatment.—The eye is kept closed for twenty-four hours with a compress and bandage, and atropine applied until absorption be completed.

Division through the Sclerotic—Scleriticonyx.—The patient being prepared as before:—

1st Step.—The needle is passed through the sclerotic $\frac{3}{10}$ ths of an inch from the corneal margin at the temporal aspect, and in a line with its transverse diameter. The direction is at first perpendicular to the surface, and is then changed by guiding the handle well backwards, and the point of the needle carried between the iris and lens to the opposite side of the pupil.

2nd Step.—The capsule is now divided, as in the previous operation, and the needle withdrawn.

This method of operating is rarely used.

Rectilinear Extraction is used for removal of soft cataracts between the ages of ten and thirty, and also supplementary to solution. This operation is Von Græfe's modification of one proposed by Gibson.

1st Step.—Pass a needle, and lacerate the capsule, as in the operation of keratonyxis.

2nd Step.—(Remove the lens by a small straight opening in the cornea.) From three to six days after the first step has been accomplished, an opening is made in the cornea, just outside the pupillary margin, the eye being under the influence of atropine. A broad cutting needle is used, and passed, as Bowman advises, obliquely through the cornea.

3rd Step.—The needle is withdrawn and a curette passed, which evacuates

the lens matter. This operation is inferior to the next.

Removal by Suction (Teale).—Anæsthesia is secured by cocaine or chloroform, according to whether the operation be performed on the adult or child.

1st Step.—This is similar to the operation of keratonyxis, but it is best to use two needles, and to break the lens up thoroughly.

2nd Step.—This may be performed at the same time, but is best done at an interval of three or four days. The pupil is dilated with atropine. A broad needle is made to pierce the cornea just within the margin of the pupil, and effect an incision sufficiently large to allow the entrance of the suction curette. The curette consists of three parts: a slender silver tube the size of an ordinary curette, but roofed in to within one line of its extremity, forming a tube flattened on its upper surface, and terminating, as it were, in a small cup; secondly, a glass tube to which the curette is attached, and which serves as a receptacle and a handle; thirdly, an india-rubber tube about a foot long with a glass mouthpiece; this tube is attached to the other extremity of the glass tube. The suction curette, previously well washed in Condy's fluid, is passed into the anterior chamber, and carried back until it be almost in contact with the posterior lens capsule. By gently sucking the glass mouthpiece, the lens matter passes through the curette into the glass tube.

Variety.—Weir's suction instrument may be used instead of Teale's. This instrument has a small metal syringe attached to the glass tube instead of the india-rubber tube. The syringe can be worked with one hand.

The suction operation is used for soft cataracts, diabetic cataracts, accidental or traumatic cataracts in children or young adults, and if necessary, to remove the lens secondary to the operation for division.

Operations for Hard Cataract.—1. Flap extraction. 2. Scoop extraction. 3. Modified linear.

The operation is not performed until the cataract be mature; that is, the opacity involves the surface of the lens, which is opaque up to the margin of the capsule: the signs of maturity are that by focal illumination *no* shadow from the iris can be seen on the capsule on the side from

which the light comes; whereas if there be some portion of the lens still transparent between the opaque part and the capsule, a crescentic shadow is cast on the opacity: by examination with the ophthalmoscopic mirror, no red light should be reflected anywhere from the fundus; the cortex must not present well-defined glistening sectors.

Instruments required for extraction.—

1. Atropine drops. 2. Anæsthetic, or 4 per cent. solution of cocaine. 3. Speculum. 4. Cystitome. 5. Toothed forceps. 6. Cataract knives. 7. Scoop. 8. Platinum spatula to adjust the edges of the wound. 9. Small sponges. 10. Basin and water. 11. Bandages and compresses. 12. Lint and absorbent cotton.

Flap Extraction.—The patient lies on a couch with his head slightly raised, and the surgeon stands behind the patient when operating on the right eye, and in front for the left.

1st Step. *Section of the Cornea*.—The upper lid is raised by the index finger of the operator, and its tarsal margin gently pressed against the orbit, whilst the middle finger is placed against the inner side of the sclerotic to prevent the eyeball rolling inwards. An assistant takes charge of the lower lid and depresses it against the malar bone; if thought advisable, he may also raise the upper lid, leaving the operator's left hand free to fix the eye with fixation forceps. The point of a Sichel's knife, with the cutting edge upwards, punctures the cornea at its outer side, a line from its margin, and just at its transverse diameter, and is pushed straight across the anterior chamber; then it makes a counter-puncture exactly opposite its point of entrance. By pushing straight onwards the flap is completed, the edge of the knife being directed slightly forwards as the incision is finished. The eyelids are closed for a moment.

2nd Step. *Laceration of the Capsule*.—A pricker, or Græfe's cystitome, is introduced sideways, and the anterior capsule lacerated in its entire length. The eyelids are again closed for a moment.

3rd Step. *Removal of the Lens*.—Steady gentle pressure is made with the curette against the lower lid, at first backwards, and then upwards and backwards, whilst the forefinger of the left

hand is gently pressed against the globe. Any pieces of cortical matter must be removed in a similar manner, and the eye closed.

Accidents which may happen during the Operation.—1. *Premature escape of the aqueous*, pushing the iris over the knife. The surgeon must draw the point of one finger over the cornea from below upwards, and continue the section with the edge of the knife directed forwards; in this way the iris is often disengaged from the blade. Sometimes the iris is unavoidably cut, resulting in deformity, but otherwise not affecting the operation. If a fold of iris be incised, producing a false pupil above the natural one, the false and natural pupils must be thrown into one by dividing the isthmus before lacerating the capsule. 2. *The section may be too small*; in this case it must be enlarged by a secondary knife. 3. *The vitreous humour may escape before the lens*; in this case a scoop should be at once introduced well behind the lens, which should be brought out, if possible, in its capsule. Should the vitreous humour escape *with* the lens the eyelids should be at once closed. 4. Lastly, the most serious accident which may occur is *intra-ocular hæmorrhage* from the vessels of the choroid, filling the eyeball with blood and utterly destroying vision.

Cases suitable for Flap Extraction.—

1. In all operations for extraction of cataract it is essential that there should be good perception of light, the patient being able to recognise the shadow of a hand passed between his eye and the window, also to be cognisant of the light from a candle held before him. The field of vision must not be diminished, which is ascertained by moving about over the field of vision a second candle, whilst the patient looks at the first candle. 2. Steadiness of the patient during and after the operation. 3. The eyeball should not be prominent. 4. The cornea must be healthy (an arcus senilis need not prevent the operation). 5. Thin wiry patients are best. 6. The iris must be free from synechia, and the pupil normal. 7. The state of the lids and tear passages must be examined, and if there be a purulent discharge this must be first removed.

Conditions prohibiting operation.—Extensive heart disease, chronic albu-

minuria, violent cough or sneezing. Extraction by the flap operation gives, if successful, a most brilliant result, but there is a great risk of iritis and suppurative keratitis.

Scoop Extraction (Waldeau's Modification of Von Græfe's).—Anæsthesia is procured by cocaine or chloroform, and the eye fixed with a speculum and fixation forceps.

1st Step. *Incision of the Cornea.*—This is made at the upper part of the scleroticocorneal junction with a bent lance-shaped iridectomy knife, or better, as recommended by Streatfeild, with the point of a Sichel's extraction knife introduced at the right extremity of the incision, and held vertically whilst the incision is made as far as necessary to the left.

2nd Step. *Iridectomy.*—A considerable portion of the iris must be removed.

3rd Step. *Laceration of the Capsule* with a pricker, or Græfe's cystitome.

4th Step. *Introduction of the Scoop.*—The scoop (Bowman's) is introduced through the wound, with its convexity backwards, to the upper border of the lens, and insinuated within the capsule by slight lateral movements. It must be directed first backwards, then downwards, behind the lens, and slightly forwards to engage the lens in its hook-like end. The handle is then depressed and the lens and instrument withdrawn together. This operation is seldom performed except in cases of dislocation of the lens.

Græfe's Modified Linear or Flap Extraction.—This is the best operation for hard cataract, and the one generally performed. Cocaine will secure the necessary anæsthesia, and the eye must be fixed with a speculum and fixation forceps. It is best to apply a cocaine disc also to the eye which is not to be operated on. All instruments should be cleaned in hot water and dipped into absolute alcohol before being used, and then wiped dry. The eye must be washed with a 20 per cent. solution of boro-glyceride by means of a drop-pipette.

1st Step. *Incision.*—Von Græfe's cataract knife, with the cutting edge upwards, is entered immediately behind the corneal margin, at the upper and outer part. The point is first directed to the centre of the eyeball, but when the anterior chamber is reached it is turned

so as to pass parallel to the iris downwards and inwards, until the point of the knife have advanced nearly to the lower edge of the pupil. The handle is then lowered into a horizontal position, and a counter-puncture made at a spot opposite the place of entrance. The blade is pressed on and turned forwards to complete the incision, the middle point of which is a little anterior to the puncture and counter-puncture. The patient then closes the lid for a moment.

2nd Step. Iridectomy.—The excision of the iris reaching the extremities of the wound and extending quite to the ciliary margin.

3rd Step. Laceration of the Capsule.—This is effected by Græfe's cystitome.

4th Step. Evacuation of the Lens.—This is achieved by pressing gently and sliding upwards the curve of a curette against the lower part of the cornea, the eye being pulled somewhat downwards with fixation forceps. If the lens will not escape, or if vitreous appear, a blunt hook or scoop must be used.

5th Step. Clearing the Pupil and Coaptation of the Wound.—A little friction and pressure with the finger on the closed lids will remove any cortical matter remaining in the pupil. The wound is cleared from coagula with iris forceps. McKeown uses injections of distilled water to wash out the capsule and remove soft cortical matter by means of a syringe. This is often useful, and an irrigator may be used instead of a syringe. A small spatula is used to adjust the edges of the wound.

Modification.—Some surgeons prefer to confine the incision wholly to the sclerotic, close to its junction with the cornea. Streatafeld used a Sichel's knife.

After-treatment.—As soon as extraction is completed, and the parts adjusted, the eye should be closed, and a Liebrich's bandage applied. The patient is placed in bed in a darkened room. Chisholm and Michel use a piece of plaster to close each eye, extending from the cheek to the brow, and from one canthus to the other, $2\frac{1}{2}$ inches long and $1\frac{1}{2}$ inches wide; the patient is not kept in the dark and no compress is applied. The plaster is cut out at each canthus, to allow of drainage or the insertion of drops (Snell). Snell

uses salicylic isinglass plaster. On the fifth day after the plaster treatment, both eyes are liberated and a shade worn. To ensure sleep, a hypodermic injection of morphia may be given. A moderate but nutritious diet is allowed, and stimulants, if thought necessary, or the patient have been used to them. The bandage must be changed night and morning. The eye should not be examined until the fourth or fifth day, and after a flap extraction not before the seventh. If there be no pain, puriform discharge, and the upper eyelid be not red or swollen, the case is progressing favourably. After twelve days the bandage can be given up and a shade worn; after the eighteenth day, neutral glasses instead of a shade.

Mishaps which may follow Extraction of Hard Cataracts.—1. *Prolapse of the Iris* from the first to fourth day (*vide Wounds of Cornea*). 2. *Iritis* (*vide Traumatic Iritis*). 3. *Suppurative Keratitis* (*q.v.*). 4. *Corneal fistula*, from imperfect union of the wound. This is treated by a compress bandage, atropine drops, and touching the fistula with nitrate of silver. Generous diet. 5. *Suppuration of the Globe.*—Vision is lost. Treat with warm fomentations, generous diet, and opiates. 6. *Cystoid Cicatrix.*—When the incision has been made in the sclerotic, and the edges have not closely united, the cicatrix bulges, particularly in glaucomatous eye. If small, this should be left alone; if large, puncture with a broad needle; when the eye is glaucomatous perform iridectomy. 7. *Spasmodic Entropion*, which is best treated by painting the lower lid with contractile collodion.

Capsular Cataract.—This term is applied to localised opacities of the capsule, whilst the remainder of the lens is clear as after iritis or ophthalmia neonatorum. These cataracts are usually central, but occasionally form a white ring round the border of the lens.

Capsulo-Lenticular Cataract consists in opacity of the lens and also of the capsule, especially the anterior layer.

Treatment.—The extraction operation is performed, but instead of lacerating the capsule with the cystitome, a pair of iris forceps is passed through the wound, the capsule seized and withdrawn, and then the lens removed as usual (Bowman).

Traumatic Cataract and Dislocation of the Lens.—Wounds of the lens or capsule are almost invariably followed by cataract. Penetrating wounds of the cornea are often complicated with injury to the iris and lens. As in the operation by solution, the capsule being lacerated, the lens becomes opaque and partially or wholly dissolved. If the lens swell rapidly it is apt to press on the iris, leading to irido-choroiditis and traumatic glaucoma. The lens may also become opaque from a blow on the eye or orbit without rupture of the globe, or even laceration of the capsule.

Treatment.—Keep the iris dilated with atropine, and apply belladonna lotions. Iodoform dusted on the wound. The patient must be kept in a darkened room, and iced compresses should be applied to the injured eye, both eyes being excluded from light. When there is much pain apply three or four leeches. If complicated with injury or prolapse of the iris, this must be treated, and the lens left until the eye have recovered. Should traumatic glaucoma supervene, the lens must be extracted at once by rectilinear extraction, combined with iridectomy, or in aged persons by the scoop or Von Graefe's operation.

Dislocation of the Lens may result from a blow or fall. It may be complete or partial. When complete it may occupy one of three situations: 1. Anterior chamber; 2. Vitreous body; 3. Beneath the conjunctiva. If the dislocation occur in the anterior chamber it sinks to the lower part, and looks like an oil globule with a rim of gold. It may occasion traumatic glaucoma, and should be at once removed, the pupil being contracted with eserine, and the lens fixed with a needle, as it is apt to slip back into the vitreous during the operation. In children it is best removed by suction or rectilinear extraction; in adults, by the scoop or Von Graefe's method. When the lens is displaced into the vitreous, if quite separated, it may be lost to sight, the depth of the anterior chamber is increased, and the iris is tremulous: the eye is very hypermetropic when examined by the ophthalmoscope, and sometimes the lens can be detected. If the lens be still attached to the suspensory ligament, and swinging to and fro as on a hinge, should there be no irritation, it may be left alone and the case carefully watched;

but if inflammation arise, an attempt must be made to remove it by a scoop operation. A lens situated beneath the conjunctiva has escaped through a rupture of the sclerotic, generally in or just behind the ciliary region; it is seen as a small, roundish, semi-transparent swelling under the upper lid, and far back; the iris is tremulous. The treatment consists in incising the conjunctiva with scissors or the knife, and removing the lens with a scoop.

Capsular Opacities.—After extraction or absorption, the capsule, in the form of a delicate film or bands, may obstruct the pupil, or if any iritis have occurred the opacity will be dense from exudation of lymph, and the iritis adherent to it. An operation should not be performed until the eye have thoroughly recovered from the previous operation. The opaque capsule can generally be removed by a needle operation. The eye speculum and fixation forceps being applied, Bowman's fine needle is passed through the cornea, about $1\frac{1}{2}$ lines from its border, directed across the pupil to the opposite side, the capsule punctured close to the iris, and a hole made in the centre. If this do not succeed, Bowman passes a second needle from the opposite side, and transfixing the capsule with one needle tears it with the other. Should there be posterior synechia, the opaque capsule is cut through with Wilde's canula-scissors (*vide* Iridotomy), or canula-forceps may be introduced and the opaque capsule withdrawn after the adhesions have been separated by Streetfield's operation. The after-treatment consists in applying atropine for several days.

Cataract Glasses.—When the lens is removed its place must be taken by a glass biconvex lens of appropriate power. For reading, a lens of fourteen to fifteen dioptries, and for distant objects, one of ten dioptries will usually suffice.

Glaucoma may be acute, chronic, or secondary to inflammation or injury of the structures of the globe. The term is applied to over-distension of the eyeball, whether caused by undue secretion or obstruction to outflow.

Premonitory Symptoms.—1. Intermittent attacks of dimness of vision, which is better one day and worse another. 2. The patient sees haloes round luminous objects. 3. Rapidly increasing presbyopia. 4. Diminution of the field of vision,

and fading sight. 5. *Eyeball preternaturally hard to the touch; in other words there is increased tension.* 6. Diminution of the field of vision, especially on the nasal side.

Causes.—It occurs in patients beyond middle age, especially after fifty. It is frequently met with in persons who are debilitated or in bad health. Anxiety and mental distress. It is most common in hypermetropic eyes, especially if also astigmatic. Both eyes may be attacked at once; but more usually one eye is first affected, and after a varying interval, the other.

Acute Glaucoma may supervene on the chronic form, or may occur suddenly.

Subjective Symptoms are those before cited as premonitory, but are very sudden in onset, rapid in their progress, and vision may be so diminished in a few hours that the patient cannot count fingers or distinguish the largest test type. Pain of a severe bursting kind in the eyeball, and circumorbital and supraorbital neuralgic pain running along the side of the head and the back of the neck. These pains are often most severe towards midnight.

Objective.—1. Increased tension, varying from the least degree T^1 , to stony hardness T^3 . Tension is determined by making the patient look downwards, and feeling the amount of resistance through the upper lid with two index fingers. Normal tension is represented by the symbol T_n ; increased tension, T^1 , T^2 , and T^3 ; diminished tension, $-T^1$, $-T^2$, $-T^3$. 2. The sclerotic is traversed by large, purple, tortuous veins, emerging abruptly in front of the insertion of the recti, close to the cornea. Sometimes there is also a marked sclerotic zone around the cornea; occasionally conjunctival injection with chemosis. 3. The pupil is sluggish, or fixed and dilated. In advanced cases it assumes an ellipsoid shape with its long axis horizontal. 4. The anterior chamber is diminished, the iris being close to the cornea. 5. The iris becomes of a slate colour, and pervaded by varicose veins. 6. The cornea is uneven, and may be dim and rough like ground glass. 7. Aqueous humour is cloudy. 8. The lens is brought near to the cornea, and is sometimes cloudy. 9. Severe vomiting is often present, leading to the disease being mistaken for a bad bilious attack. 10. The field of vision

is always contracted for white light, when tested by the perimeter, first over the inner, and then the upper and lower portions, the centre and outer parts remaining unaffected. The contraction of the field for colours diminishes in exactly the same manner, and *pari passu* with the contraction for white light.

11. *Ophthalmoscopic Appearances.*—These, when the fundus can be seen, are best observed by the direct method. The chief change is *cupping of the optic disc* (glaucomatous cup), which is caused by yielding of the surface of the optic nerve from the increased pressure. The excurvation involves the whole of the optic disc, its margin is abrupt, overlapping the cup, and the vessels as they curl over the edge appear interrupted or distorted; the base is white with a bluish tinge, showing frequent mottlings corresponding to the pores of the lamina cribrosa. Outside the disc is a light-coloured ring due to the sclerotic shining through the atrophied choroid. In advanced cases the disc is of a bluish grey colour. By the direct method a concave glass is required behind the mirror to make the vessels at the bottom of the cup distinctly visible, and if the observer's head be moved from side to side the bottom of the cup appears to move in the same direction as the head; by the indirect method, the vessels at the bottom of the cup do not move so quickly with the observer's head as those at the edge. The retinal veins are dilated and tortuous, and pulsate visibly, the blood being forced from the centre of the disc to its circumference, with blanching of the disc, and returning in the opposite direction. The arteries also in advanced cases have a visible pulsation either spontaneously or on the slightest pressure. Small extravasations on the retina are often present, or clots in the vitreous.

Progress.—After one or more attacks the eye will be totally blind.

Treatment.—Sulphate of eserine grs. ij to ʒj should be applied to the eye at intervals, provided the pupil be free to contract. As soon as possible an antiphlogistic iridectomy must be performed. Another method which is used, but is more to be recommended in chronic glaucoma, is *Sclerotomy*. The pupil is contracted with eserine, and an incision made with a Grafe's cataract knife through the sclerotic just outside its

junction with the cornea, the knife being made to penetrate the anterior chamber, and then transfixing at a counter-puncture opposite its point of entrance. The blade cuts its way out until only a tag of tissue be left to prevent prolapse of the iris. The incision comprises a third part, usually the upper of the entire circle in which it lies. This operation is useful in hæmorrhagic glaucoma and in cases of absolute glaucoma, and in young persons.

Paracentesis of the Vitreous (Cowell) is performed between the insertions of the superior and external recti, by piercing with the point of a Sichel's cataract knife, through the conjunctiva, sclerotic, choroid, and retina. The incision should be 6.5 millimetres from the corneal margin. This operation is used in chronic and secondary glaucoma, and is the best operation where the anterior chamber is entirely wanting. Other operations which have been recommended are hyposcleral cyclotomy, or an antero-posterior incision through the ciliary body; and trephining the sclerotic (Argyll-Robertson), about the level of the ora serrata, with a steel cylinder, opening the vitreous chamber. If the eye be totally blind from old neglected glaucoma, Mules' operation should be performed.

Chronic Glaucoma presents similar symptoms to the acute, but these advance slowly with intervals of quiescence, and are not attended with pain. Frequently an acute attack supervenes.

Treatment.—Iridectomy or sclerotomy should be performed, but will not restore the vision which has been lost, although the progress of the disease be stayed and what sight remains be preserved. Sulphate of eserine is a valuable adjunct.

Secondary Glaucoma. Causes.—Punctured wounds in which the lens is injured; after needle operations or dislocation of the lens (traumatic glaucoma). As a sequence of iritis, irido-choroiditis, staphyloma, sympathetic ophthalmia, and deep ulceration of the cornea.

Treatment.—Remove the cause, if possible, and perform iridectomy, or one of the other operations before mentioned.

Rationale of the Operations for Glaucoma.—The escape of fluid from the interior of the globe is essential, and always takes place in health. The chief means by which this occurs is through the "filtration area," or ring of tissue,

directly posterior to the margin of the cornea, and anterior to the ciliary margin of the iris. This area is traversed by the canal of Schlemm, with its contained plexus of veins, which are the principal agents of filtration. In order that the transudation may progress normally, the anterior part of the iris and the posterior part of the cornea must form an open angle, but should this be obliterated by the iris being pushed forward, or united by adhesions to the cornea, glaucoma results. After iridectomy or sclerotomy this filtration area is opened, and a vent given to the accumulated fluids.

Diseases of the Vitreous Body.—*Hyalitis* or inflammation of the vitreous may occur secondarily to disease of the iris, choroid, or retina; or subsequent to some injury, such as the entrance of a foreign body, or a perforating wound. In non-suppurative hyalitis there is haziness of the vitreous, with small filmy opacities consisting of opaque connective tissue or freshly effused lymph, which is more abundant near the ciliary body. When hyalitis has continued for some time, the vitreous becomes fluid (synchysis) and shrunken, and finally is converted into a tough dirty-grey substance.

Suppurative Hyalitis occurs in general suppuration of the globe; pyæmia; direct perforation of the vitreous by septic instruments; and subsequent to suppurative irido-cyclitis. The symptoms are congestion, loss of vision, turbidity of the vitreous, giving a yellow-white appearance to the pupil, dulness of the aqueous humour and iris, and chemosis. There is great pain, with inflammatory fever. The globe is projected and loses its mobility, and there is a purulent discharge from the lid. This may terminate in shrinking of the globe, or perforation of the cornea. In some cases the suppurative process is confined to the vitreous, when the symptoms are loss of vision, ciliary congestion, turbidity behind the lens, with retraction of the periphery of the iris, resulting in shrinking and softening of the globe.

Treatment.—Local warmth, stimulants, and quinine.

Musca Volitantes are met with in myopic persons, and those who do much fine work. They consist in transparent or opaque beaded particles, floating in front

of the retina. If the patient direct his eye to a clear sky, and keep it fixed, the particles sink slowly downwards. They never impair vision, have no connexion with any organic disease, and are invisible on ophthalmoscopic examination. They consist of corpuscles of the vitreous and débris of cells, or detached filaments of hyaloid connective tissue.

Treatment.—Rest to the eyes if overstrained; tonics. There is no means of causing their disappearance.

Opacities of the Vitreous result from chronic inflammatory conditions, as in diseases of the choroid, retina, and iris. In high degrees of myopia they are pretty frequent. Their form is that of freely floating films or veils. When hæmorrhage occurs from the surface of the retina or ciliary processes, the clot may be entangled in the vitreous, in the form of an irregular, filmy, black-looking opacity, floating across the field of the ophthalmoscope. In syphilitic inflammation the opacities present a fine dust-like appearance. When the front of the vitreous is the part implicated the opacities are best seen with a convex lens behind the mirror.

Treatment is that of the disease causing them.

Sparkling Synchysis is produced by crystals of cholesterine, tyrosine, and phosphates floating in the vitreous, derived from degeneration of the lens, choroidal epithelium, or effusion of blood. They appear very bright and glistening, like fine gold dust; after movement, the particles appear in much greater numbers. Both eyes are usually affected, and the condition manifests itself in persons past middle age.

Synchysis, or Fluid Degeneration of the Vitreous.—*Causes.*—Ophthalmitis, inflammation of the iris, choroid, or retina. Sympathetic ophthalmia. Injuries to the eyeball. Posterior intraocular hæmorrhage. Hydrophthalmos. Staphyloma. The later stages of irido-choroiditis and glaucoma. Extreme myopia. Senile changes. When there has been an escape of vitreous this is replaced by aqueous fluid, but if much have been lost the eye becomes soft, and vision is lost.

Symptoms.—Ophthalmoscopically floating particles are seen, and the iris is tremulous (iridodonesis). Tension is much lessened.

Cysticercus in the Vitreous is not com-

mon in this country, though comparatively frequent in Germany. The parasite is first lodged between the retina and choroid, and then perforates the retina to enter the vitreous. The cyst is rounded with a bluish grey surface and glistening margin, the head is small and tapering, but slightly enlarged at its extremity. There is a to and fro movement of the head, and a vibratory motion of the cyst. It occasions hyalitis, followed by irido-choroiditis and shrinking of the globe.

Treatment.—Remove, if possible, through a sclerotic incision, or by extracting the lens and then withdrawing the cyst with a fine hook.

Pseudo-Glioma is characterised by inflammatory changes, leading to degeneration and shrinking of the vitreous, which is changed into a condensed, greyish white, opaque substance. This condition is characterised by diminished tension, retraction of the periphery of the lens, and absence of hæmorrhagic extravasations. It is most common in children, and often accompanies or is consecutive to some forms of meningitis.

Detachment of the Vitreous may follow shrinking from any cause, the vitreous being separated from the retina by a serous fluid. The detached portion forms a translucent, filmy, well-defined hemisphere at the back of the lens and ciliary processes, but when retaining its connexion to the optic disc is convolulus-like in form.

Hæmorrhage into the Vitreous may occur:

1. From the ciliary processes;
2. From the choroid, bursting through the retina;
3. From the retina. It is often confined to one eye and may be recurrent.

Causes.—Mechanical injury, as a blow from the fist. Spontaneously in gout, cardiac and renal diseases, hæmophilia, and anæmia. It is sometimes met with without apparent cause in young adults.

Symptoms.—When copious, sudden loss of vision, and inability to see the fundus with the ophthalmoscope. Small hæmorrhages appear, black, or if translucent, dark red when the eye is examined ophthalmoscopically; sometimes the clot can be seen by focal illumination. The blood is usually but slowly absorbed, and leads to the formation of opaque films, which may be coarse or fine, and also to floating opacities.

Results.—Resolution may occur in

favourable cases, but more frequently softening of the vitreous and detachment of the retina.

Treatment.—Rest in a dark room. All minute work, straining, or stooping must be forbidden. Iced compresses. Pressure by a compress and bandage. Iodide of potassium internally, or liq. hydrarg. perchlor.

Foreign Bodies in the Vitreous, such as fragments of steel or iron, gun caps, etc., may be detected by the ophthalmoscope, provided there be no intraocular hæmorrhage, as a dark or bright body. They may become encapsuled, but are apt to occasion severe inflammation, and to be followed by sympathetic ophthalmia.

Treatment.—Removal by an incision through the sclerotic, between two recti muscles; with the ophthalmoscope the situation is ascertained and the body is removed with forceps, but if this be impossible the eye should be extirpated. If the substance be iron or steel an electro-magnet is used, to which needles can be attached. The needle is passed into the vitreous as near as possible to the piece of steel or iron, and this adheres to the needle and can be withdrawn with it.

Diseases of the Retina.—*Hyperæmia of the Retina* may be *Active* or *Passive*.

Causes.—Of *Active*: Prolonged use of the eye for fine work, particularly in myopic or hypermetropic individuals; exposure to strong light; secondary to disease of the other structures of the globe.

Of *Passive*: Local congestion of the brain; tumours in the orbit or skull; neuritis; thrombosis of the central vein; glaucoma; suppressed menstruation; mitral disease; and emphysema of the lungs, etc.

Symptoms.—Irritability of the eye. By ophthalmoscopic examination the optic disc is seen to be red, partially or all over. In the passive form the veins are dilated, large, very dark, and tortuous.

Treatment.—Rest to the eyes. One or two leeches. Counter-irritation. The cold douche with the lids closed. Internally, iron, bark, and the mineral acids.

Retinitis, or Inflammation of the Retina, is usually the result of some general disease.

Causes.—Syphilis (retinitis syphilitica); diseases of the kidneys (retinitis albuminurica); leucocythemia, diabetes; pig-

mentary retinitis (retinitis pigmentosa); over-use of the eye. Secondary to orbital tumours, embolism or inflammation of neighbouring structures. Direct exposure to sunlight.

Symptoms.—Dim and distorted vision. The field of vision is contracted, or in portions lost, which is best tested by a perimeter (Priestly Smith's). The loss of vision may progress to total blindness.

Ophthalmoscopic Appearances.—The retina loses its transparency from exudation, and becomes milky. Optic disc swollen and red, and the outline obscured. The veins distended and tortuous, and at parts cannot be seen, owing to exudation. There may be extravasations of blood or patches of exudation into the retinal tissue, which appear as grey spots. There may be hypertrophy and sclerosis of nerve fibres, and there are often opacities in the vitreous.

Retinitis Albuminurica is found generally in connexion with chronic granular contracted kidney, but also follows other renal diseases, as the albuminuria of pregnancy, or scarlatinal nephritis. The retinal symptoms may precede the renal or succeed them. It probably results from changes in the walls of the small arteries, and altered conditions of the blood.

Ophthalmoscopic Appearances.—The retina round the disc is of a greyish white, and at various points, forming a more or less complete ring round the papilla, are to be seen buff-coloured patches. In the neighbourhood of the yellow spot white punctate glistening spots appear, arranged in a stellate pattern, due to fatty degeneration of the inner end of Müllerian fibres. Hæmorrhagic effusions of small extent are common. The papilla may be passively congested, or its surface and contour greatly blurred by effusion.

Treatment must be directed to the kidneys. A purgative every other day. Injections of pilocarpine, warm baths, etc. Leeches to the temple if the eye be painful. Tinctura ferri perchlor., etc.

Retinitis Syphilitica occurs as a late secondary or early tertiary symptom, and is often combined with choroiditis, and may attack one or both eyes. Occasionally this disease is met with in inherited syphilis.

Ophthalmoscopic Appearances.—The retina has a diffused greyish haze extend-

ing from the optic disc. The vitreous contains numerous *dust-like* opacities. Patches of ecchymosis or buff-coloured patches are rare. The disc is blurred and the veins somewhat enlarged.

Symptoms.—Night blindness is well marked with the other symptoms of retinitis. It may last for months, but is the variety most amenable to treatment.

Retinal Disease in Diabetes does not differ essentially in appearance from albuminuric retinitis. It always affects both eyes. Retinal hæmorrhages are frequent in diabetes.

Treatment.—Syphilitic retinitis must be treated by a prolonged course of mercury and other antisiphilitic treatment. In diabetic retinitis the treatment must be directed to the general condition.

Retinitis Pigmentosa is associated with pigmentary changes in the retina.

Causes.—It is often congenital, and may be hereditary. It is common in deaf mutes. Consanguinity of the parents. Several members of a family are often affected.

Symptoms.—It commences as a rule in early life, and is very chronic, and attacks both eyes. The first changes are circumferential blindness, the field of vision gradually contracting, although a small field in the centre retains clear vision for a lengthened period. Night blindness is an early symptom. After a considerable time central vision becomes impaired, and finally all vision may be lost.

Ophthalmoscopic Appearances.—Stellate deposits of black pigment and irregular black striation in the form of threads or dots upon and around the retinal vessels. The pigmentary deposit is thickest midway between the centre and periphery, where it forms an annular zone. The optic disc is anæmic, pale, of a yellowish red or greyish yellow colour; the central vessels are small. There is no atrophy of the choroid.

Treatment.—Galvanism, and internally some preparation of iron. Perchloride of mercury. Bromide and iodide of potassium. Hypodermic injections of strychnia.

Retinal Disease in Leucocythemia is symmetrical.

Ophthalmoscopic Appearances.—White patches surrounded by a hæmorrhagic border occurring at the periphery and near the centre of the fundus, with the

other signs of retinitis. The retinal arteries are bright orange in colour, and the veins light carmine.

Treatment.—That of the disease on which it depends.

Hæmorrhagic Retinitis usually only implicates one eye. It is characterised by numerous small hæmorrhages, which are diffusely spread over the fundus. It is caused by some disease of the vascular system, or cardiac valvular disease, aneurism, degeneration of the arteries, suppression of the menses.

Treatment.—Iodide of potassium, etc.

Retinal Hæmorrhage. Causes.—From rupture of a vessel, or diapedesis. Rupture occurs from increased intravascular pressure, which may be local, as from blows on the eyeball, venous thrombosis, retinitis, and optic neuritis; or general, associated with disease of the heart, gout, suppression of the menses, etc. Another class of cases in which the vessels may give way is where, as the result of operative interference, or accidents, the contents of the globe are suddenly diminished and the retina loses its normal support. Thirdly, the arterial wall may be of a more brittle character than normal, and so give way, as in Bright's Disease, miliary aneurism, with embolism and thrombosis of the small arteries, degeneration of the coats of the vessels, etc. Diapedesis or migration of the corpuscles without rupture is occasioned by increased blood pressure, or an altered condition of the blood, as in leucocythemia, purpura, scurvy, hæmophilia, anæmia, ague, pyæmia, diabetes, etc.

Symptoms.—Impairment or loss of vision which has a *sudden* onset. The pupils are dilated and sluggish. No pain or photophobia.

Ophthalmoscopic Appearances.—Extravasations of blood, varying in extent and number. The extravasation may occur in the nerve fibre layer of the retina, when it splits the fibres, and thus presents a striated appearance, and terminates in a brush-like extremity (flame-shaped); or the blood may be poured out beneath the limiting membrane, when it will form a rounded patch; or if profuse the blood may burst into the vitreous, or detach the retina. When recent the blood appears red, afterwards black or brown.

Prognosis depends on the extent, situation, and cause. It is favourable when

there is only a small quantity of blood on the internal surface of the retina, the patient being young, and his vessels healthy.

Treatment.—Rest to the eyes. One or two leeches to the temple. Dry cupping. Iodide and bromide of potassium. Iced compresses. Keep the bowels open with Hunyadi Janos water, or sulphates of soda and magnesia. Attend to the uterine functions and any accompanying disease. Subcutaneous injection of pilocarpine is often useful.

Detachment of the Retina from the Choroid.—Floating Retina. Causes.—Extreme myopia. Loss of vitreous. Hæmorrhage between the choroid and retina. Serous exudation between the retina and choroid, as the result of acute or chronic inflammation. Tumours of the choroid. Cicatricial contraction of connective tissue bands in the vitreous.

Symptoms.—This condition generally commences at the lower part of the fundus and affects one eye. Loss of vision affecting that portion of the field corresponding to the detached part of the retina. On moving the head a shadow waving up and down may be perceived by the patient. Objects are often distorted. Phosphenes of the detached parts are absent. It is often sudden in its onset.

Ophthalmoscopic Appearances.—The pupil should be well dilated, when a portion of the fundus appears bluish grey. By direct examination the detached part presents itself as an opaque greyish film, bulging forward into the vitreous, and bounded by a sharp line, beyond which the choroid is seen shining through the normal retina. The discoloured piece floats with a tremulous motion, and is folded or wrinkled. The vessels of the detachment are thin, dark, suddenly bend at the junction with the healthy retina, and have a wavy, tortuous appearance. The anterior surface of the displacement will require a convex lens to render it clearly visible, and the power of the lens necessary is an estimate of the depth of the detachment. If a portion of the retina be only loosened and wrinkled without being detached, the diagnosis is very difficult.

Prognosis.—In the majority of cases the detachment extends until there is complete loss of useful vision. Cataract may supervene.

Treatment.—Wolfe's method has had

considerable success. The conjunctiva is separated from the sclerotic up to a point where it is intended to incise it. The sclerotic is punctured with a Graefe's cataract knife at the equator; the incision may be made between the inferior and external rectus, or any other spot which is found from examination to be more convenient. If the right spot be reached, yellow serum will escape when the wound is made to gape somewhat. A fine grooved director may be introduced to aid the flow of fluid. Rest in bed for several days in a dark room is essential, and a pressure bandage should be applied to the eye when the puncture has healed. Eserine drops and jaborandi internally are of service, or pilocarpine hypodermically. The bowels must be well regulated, and all strains or exertion avoided. Prolonged rest of both eyes is requisite.

Embolism of the Central Artery of the Retina. Causes.—Cardiac valvular diseases. Albuminuria. Advanced pregnancy.

Symptoms.—Sudden unilateral blindness without pain. It is more common in young persons. If only a branch be plugged, the blindness is partial.

Ophthalmoscopic Appearances.—The optic disc is pale and its edges indistinct; the retina becomes œdematous, presenting a white misty opacity which obscures the choroid, except at the yellow spot, which is unusually red by contrast with the adjacent retina. The vessels are small at the disc and look like white lines, or narrow red lines with opaque white bounding lines. Small hæmorrhages may be present. There is no pulsation on pressure. After some interval the retina recovers its transparency, but the optic nerve gradually atrophies.

Treatment.—Massage of the eyeball to try and loosen the clot is the only measure which has a chance of success, but the prognosis is very unfavourable.

Glioma of the Retina.—This is a tumour springing from the retina and belonging to the sarcomatous type. It consists of cells generally round like lymph cells, occasionally spindle-shaped, enclosed in a delicate fibrillated reticulum, but sometimes this is absent, and between the cells there is an amorphous intercellular substance. It is apt to undergo fatty, mucoid, and calcareous degeneration. It resembles brain substance in appearance.

Causes.—It occurs in young children under five. It may be congenital.

Symptoms.—Loss of vision; dilatation of the pupil; bright yellow appearance of the pupil. As the disease advances there will be increased tension and pain. The lens and iris are pushed towards the cornea. The lens become cloudy, and the cornea dull; finally the tumour bursts through the coats of the globe, forming a fungating mass, and death occurs from exhaustion, or extension by means of the optic nerve to the brain, producing meningitis. The scalp, brain, and adjacent lymphatic glands may be the seat of secondary deposits, and occasionally other organs, as the liver. By focal illumination a yellowish white mass is seen in the vitreous with blood-vessels and perhaps hæmorrhages on its surface.

Treatment.—Extirpate the globe with as much of the optic nerve as possible. Pain is relieved by opiates. It is apt to return if the nerve be already much affected.

Disseminated or Exudative Choroiditis.

—*Causes.*—Syphilis, but it may occur spontaneously (simple). When syphilitic it may accompany iritis and appear as a secondary symptom, or may be conjoined with retinitis when it is tertiary. On the subject of causation Hutchinson writes, that the following propositions must be admitted: (1) That concussion of the eyeball may produce conditions closely resembling those of other forms of choroiditis, but always limited to the eye injured; (2) That choroiditis disseminata, affecting both eyes, is occasionally met with as a family disease, independently of syphilis, and in association with diseases of the nervous system, especially the intellect; (3) That there are cases of choroiditis occurring in fairly healthy persons, which show a remarkable tendency to recurrence, are accompanied by iritis, and ought possibly to be grouped with relapsing cyclitis; (4) That young men are liable to a peculiar form of hæmorrhagic choroiditis, which is not dependent on syphilis, but which produces results not to be distinguished from the syphilitic forms; (5) That there are yet other forms of disseminated choroiditis which cannot be assigned to any of the above groups, but which closely resemble in their final results what is observed in syphilis, but in which there is still no reason to suspect the disease.

Symptoms.—Gradual failure of vision. *Musæ.* The field of vision is contracted or imperfect. The pupil somewhat dilated and sluggish. Little or no intolerance of light.

Ophthalmoscopic Appearances.—Pinkish yellow-coloured patches of exuded lymph are seen on the surface and in the substance of the choroid. In the syphilitic form, the exudation consists of nodules distinctly circumscribed. As the disease progresses the vitreous may become hazy. When the exuded lymph is absorbed the part of the choroid affected atrophies, and the corresponding part of the white sclerotic appears shining through the atrophied choroid. Round these white patches the pigmented unaltered choroidal epithelium forms a black rim. The retina is usually unaffected in front of the choroid.

Sequelæ.—Posterior staphyloma. Glaucoma.

Treatment.—The eye must be shielded from light. Eserine drops. Local abstraction of blood. Counter-irritation. Hypodermic injection of pilocarpine. In the syphilitic form, when secondary, mercurial baths or inunction, and iodide of potassium. If tertiary, hydrarg. perchlor. with a bitter infusion, followed by iodide of potassium. If the patient be weak, ung. hydrarg. and belladonna rubbed into the temple every night, and quinine and iron. In the simple form, iodide and bromide of potassium, arsenic, etc.

Sclerotico-Choroiditis Posterior, or Posterior Staphyloma, is a conical protrusion backwards of the posterior half of the eye, accompanied with atrophy of the choroid. It is usually found in all cases of severe myopia.

Symptoms.—If *stationary*, those of myopia; if *progressive*, increasing myopia and failure of vision, with symptoms of retinal irritation, as *musæ*, flashes of light, etc.

Ophthalmoscopic Appearances.—A large white crescent on the outer side of the optic disc, due to the sclerotic shining through the atrophied choroid. Outside this is a border of pigment. In bad cases these appearances may extend all round the disc. The retinal vessels are very distinct on the white ground. Patches of atrophied choroid are often present.

Sequelæ.—Glaucoma, detachment of the retina, choroidal hæmorrhage, hyalitis, cataract.

Treatment.—That of myopia. Liq. hy-

drarg. perchlor. if the staphyloma be increasing.

Suppurative Choroiditis v. Ophthalmitis v. Panophthalmitis is inflammation involving all the structures of the eye.

Causes.—Injuries, chemical or mechanical. In debilitated patients, puerperal pyæmia. Endo-carditis. Cerebro-spinal meningitis. After the exanthemata.

Symptoms.—Inflammatory swelling of the cellular tissue of the orbit round the globe and of the lids. Severe conjunctivitis with chemosis. Aqueous is serous, then turbid from lymph and pus. Iritis, keratitis, cyclitis, hyalitis, retinitis, and choroiditis are all present. The pain is unbearable at first, of a neuralgic character over one side of the face and head, afterwards hot and throbbing. Intolerance of light, and lachrymation; marked inflammatory fever.

Prognosis.—Occasionally resolution takes place under treatment, but most frequently suppuration progresses until the cornea or sclerotic give way.

Treatment.—Atropine drops or discs used three times a day. Belladonna fomentations. Rest to the eyes. Opium to relieve pain. Salines and diaphoretics, followed by quinine and the mineral acids. Beef tea, wine, or brandy. If hypopyon be present, tap the cornea, and, should the pain diminish, this proceeding must be repeated as occasion demands. If the disease still progress, evacuate the pus through the sclerotic. Extirpate the globe when acute symptoms have subsided; if performed before this time death may ensue from purulent meningitis.

Sarcoma of the Choroid may be of the ordinary type or melanotic. It commences in the choroid, appearing first as a small nodule, then detaches and pushes forward the retina, displacing the vitreous and pressing on the iris, ciliary body, and lens. The globe may lose its normal shape, and dark bulgings be visible in the ciliary region. The cornea is then affected by the pressure, and ulcerates; or in other cases the sclerotic gives way and the tumour presents externally; then it grows with increased rapidity, forming a fungus hæmatodes.

Symptoms.—Loss of vision. Increased tension and pain, with the other symptoms of glaucoma. Sometimes with the ophthalmoscope the vessels of the detached part of the retina can be distin-

guished lying in front of other vessels belonging to the tumour, this proving that the case is not simply one of detached retina.

Prognosis.—If removed, recurrence may not take place for years. Any organ may be secondarily implicated.

Treatment.—Extirpation of the eyeball as soon as the tumour is detected. When the coats of the globe have given way remove the whole of the orbital contents with chloride of zinc paste, having first extirpated the globe.

Injuries of the Choroid are followed immediately by hæmorrhage. The choroid may be torn by a blow on the eye, with or without rupture of the external coats, or by a penetrating wound. Hæmorrhage may ensue between the choroid and retina, producing a clot, which detaches the retina, rendering the eye more or less blind, according to the extent of the extravasation. Hæmorrhage between the choroid and sclerotic is apt, in unhealthy eyes, to follow wounds of the external coats and escape of the lens. The choroid is stripped from the sclerotic and, with the retina and vitreous, pushed forwards.

Prognosis.—If the hæmorrhage be extensive, detaching the retina, eyesight is generally lost.

Treatment.—Leeches to the temple. Atropine drops. Complete rest for a long period to both eyes, with a compress and bandage. Cold water lotions to the injured eye.

Optic Neuritis is of two kinds: 1. Descending; 2. Ascending.

Descending Optic Neuritis. Causes.—1. Most commonly any "coarse" disease in the cerebrum or cerebellum, as tumours, meningitis, hydrocephalus, abscess, hydatid disease of the brain, cerebral softening, inflammation propagated by continuity of tissue. 2. Local lesions in the orbit, as nodes. 3. Subsequent to injuries of the head and spine, when it often comes on at a considerable interval, the patient having apparently recovered. The immediate cause is obstruction to the venous circulation.

Symptoms.—At the commencement, increased redness of the disc, later a greyish white woolly appearance. The optic disc is swollen and prominent, bulging forwards (engorged disc); the swelling affects a greater or less extent of retina, which is milky and loses its

transparency, thus rendering the outline of the disc irregular and indistinct. The arteries are small and the veins large and tortuous (choked disc); and through the swelling of the optic nerve the vessels are pushed forward, forming well-marked curves. Small extravasations may be present, and patches of degeneration in the retina. Vision gradually fades without pain at the centre of the field, and there is also progressive diminution of the field from the periphery. Colour vision for green and red may be lost. Symptoms of the exciting disease are present.

Ascending Optic Neuritis, or Neuro-Retinitis. Causes.—Syphilis, uterine disease, debility after fevers, diphtheria, over-lactation, etc., lead poisoning, diabetes, chlorosis, suppressed menstruation, renal disease, local lesions of the eye (as ulcer of the cornea), errors of refraction, etc.

Symptoms.—The disc is clouded, and the outline faintly marked; vessels indistinct as they pass over its surface; the veins are not distended. The retina is widely affected, being covered with a diffused haze. Often one eye alone is affected. There are no cerebral symptoms.

Prognosis is very unfavourable.

Treatment.—For descending neuritis, that of the lesion on which it depends. Iodide and bromide of potassium and mercury. Strychnia hypodermically. Carter has opened the nerve sheath to give exit to the contained fluid. Absolute rest to the eyes.

For neuro-retinitis find out the cause and treat it; if syphilis be the origin, try antisyphilitic remedies. Wet cupping by Heurteloup's artificial leech. Absolute rest to the eyes. If uterine derangements produce the affection, attend to the menstrual functions. In anæmic persons, tonics, as the mineral acids with bark, iron, and mercurial inunction on the brow and temple.

Atrophy of the Optic Nerve.—*White Atrophy. Causes.* Extrinsic: Cerebral, or cerebro-spinal disease. Pressure from tumours, cerebral hæmorrhage, etc. Softening of the brain, hydrocephalus, meningitis, syphilitic deposits, embolism, paraplegia, locomotor ataxy. Uterine derangements, as suppression of the menses, amenorrhœa, dysmenorrhœa, pregnancy. Loss of blood. Re-

flex irritation, as carious teeth, etc. Orbital tumours. Diabetes. Intermit- tent fevers. Alcohol, lead.

Intrinsic: Diseases of the retina or choroid. Glaucoma. Acute inflammation of the eye. Intraocular hæmorrhage.

Ophthalmoscopic Appearances.—The optic disc is flat and enlarged, of a milky whiteness, and quite bloodless. The arteries are much decreased in size and scarcely visible; the veins may be at first enlarged, but are afterwards shrunken. The optic nerve may be depressed from atrophy of the nerve substance (atrophic cup). This cup consists of a gradual slope from the margin to the centre, not abrupt as in glaucoma, and the vessels are not distorted. When dependent on intrinsic causes the appearances differ, but the disc is pale, and the vessels small with indistinct outline; phenomena due to disease of the choroid or retina may be present.

Symptoms.—1. Diminution of visual acuity. 2. Impaired colour vision; first green, and then red and yellow, fail to be recognised, and finally blue disappears. 3. Alterations in the field of vision.

Treatment.—This must be directed to the condition on which it depends, and no sight which is lost can be regained, so efforts must be directed to prevent matters getting worse.

Colour Blindness, or Faulty Perception of Colours, may exist in three forms: 1. Dichromic vision. For normal eyes, there are three elements of colours,—red, green, and blue; in dichromic vision, one of these, generally red or green, is not perceived. 2. Inability to distinguish shades of colour. This may be congenital, or from over-use of the eye in looking at colours. 3. Achromatic vision. Inability to distinguish any colour. This results from disease.

Tests.—These are coloured wools (Holmgren's), coloured letters, cards, glasses, etc.

Holmgren's Test.—1. The person is given a skein of pure pale green colour, and asked to pick out all similar skeins from a heap containing several shades of green, yellow, grey, pinks, etc., without considering any difference in shade. If he select no skeins but green ones the colour vision is all right. Should he take greys, browns, or pinks, as

matches, he is red or green blind. 2. Then a pale-coloured rose skein is given him; he will match it with dark blue and violet if red blind. If green blind he will match it with grey, or bluish green. 3. Next try him with a scarlet skein; if red blind he will match it with a dark green or brown. If green blind a light brown or yellow green.

Defects of Sight Remediable by Glasses.

—These are Myopia, Hypermetropia, Astigmatism and Presbyopia. Rays of light from objects beyond five metres (sixteen feet) are for all practical purposes parallel. When a normal eye is at rest parallel rays falling on the cornea are made to converge still more by the anterior surface of the lens, and most of all by the posterior surface of the lens, so that they form a focus on the retina. This focus is the “principal focus” of the compound object-glass formed by the cornea, lens, and humours. This being the natural state of the eye, it is clear that when the rays were no longer parallel,—that is, proceeded from an object less than five metres from the eye,—such divergent rays would come to a focus at a greater distance than the principal focus that is behind the retina, but if this were the case we should not see near objects distinctly. If a clear object have to fall on the retina some change must take place, and this is produced by the action of the ciliary muscles, which involuntarily act, relaxing the suspensory ligament, and rendering the lens more convex whilst it is approached to the cornea, thus enabling divergent rays to converge more than parallel ones, and so also to come to a focus on the retina. This is termed accommodation. An eye that can see distant and near objects well is said to be *Emmetropic*.

Myopia, or Short Sight.—If in an eye at rest the retina were moved further back, or rays of light too much bent by the cornea, lens, and humours, the principal focus would lie in front of the retina, and parallel rays would form circles of dispersion on the retina, and so distant objects would not be clearly visible. This is the case in myopia. The usual defect in a myopic eye is increase in the length of the globe from elongation of the posterior half of the eye (posterior staphyloma). Myopia may also, though rarely, be due to too great refractive power in the eye, as in spasm of the

ciliary muscle, producing increased convexity of the lens, or excessive curvature of the cornea. In myopia, patients can only see objects distinctly at a short distance from the eye, as the rays from such objects being divergent are not so soon brought to a focus.

Causes.—It may be hereditary, congenital, or acquired. When hereditary, it is not usually noticed until eight or nine years of age. The acquired form occurs in persons who use their eyes much for reading, or minute objects, as engravers, watchmakers, etc. In all cases of headache in children, especially when worse on reading or working, examine the eyes for errors in refraction.

Ophthalmoscopic Appearances.—By direct examination, the fundus being illuminated by a mirror held at a distance of two feet, an *inverted* image of the fundus can be seen at some inches from the patient's eye. The retinal vessels appear to move in an opposite direction to the observer's head. When the ophthalmoscope is brought near the eye in the usual position of the direct examination, nothing will be seen unless a concave lens be placed against the sight hole of the mirror, when an erect image of the fundus will be visible. The power of the weakest concave glass which will give a distinct image of the fundus, is a measure of the extent of the myopia. By the indirect method of examination, using both a mirror and object lens, the optic nerve and vessels appear brighter and smaller than in an emmetropic eye, and as the object glass is withdrawn from the eye, the image increases in size. In most cases, on the apparent inner side of the optic disc, the large white crescent described in posterior staphyloma is present (myopic arc).

To test also for myopia, “retinoscopy,” keratoscopy, or the shadow test, is used; light is thrown from the concave ophthalmoscope mirror into the dilated pupil, and on the operator, at a distance of about four feet, rotating the mirror, a shadow passes across the illuminated area in the same direction as the mirror is turned. To ascertain the degree of myopia, the weakest concave glass is found, which, held in a spectacle frame in front of the patient's eye, will make the shadow disappear. In high degrees of myopia the fundus reflex is dull.

Complications.—Posterior staphyloma,

detachment of the retina, opacities of the vitreous, divergent strabismus.

Treatment.—Avoid over-fatigue of the eye. Cold douches. Concave glasses are necessary to render the rays of light divergent before entering the eye. In selecting the proper glasses for a patient it is necessary to ascertain the range of accommodation, degree and probable cause of the myopia, and any complications.

To test the degree of Myopia and Range of Accommodation, *Test Types* are used. For testing the distant vision, Snellen's series of letters are employed, which are arranged on a card in seven rows, bearing the numbers 60, 36, 18, 12, 9, and 6, indicating the number of metres at which a normal eye should be able to read them. This card is commonly hung up at a distance of six metres (20 feet) from the patient. The acuity of vision is expressed by a fraction, the numerator of which is the distance of the patient from the card, and the denominator the number of the smallest row of letters which is perceived. If a patient see at six metres No. 12, the fact is expressed thus: $V = \frac{6}{12}$. The near vision is tested by Jaeger's reading types, which are numbered from 1 to 20. In addition to these types a set of trial lenses are necessary, fitting into a spectacle frame. The lenses are numbered on the metrical principle, the unit of measurement being a lens with the focal length of one metre; its focal power is termed one dioptré (1 D.) A lens with twice the refracting power will, in accordance with the rule that the strength of a lens is in inverse proportion to its focal length, have a focal length of half a metre, and be termed two dioptrés (2 D.) A lens with a focal length of two metres will be called half a dioptré (.50 D.) The focal length in centimetres of any lens is found by dividing 100 by the number of dioptrés in the lens. Convex lenses are denoted by the prefix + : concave by the sign —. It is generally more convenient to express the focal length in centimetres: a lens of 1 D is 100 centimetres. The patient being seated, a spectacle frame is adjusted to his face, and an opaque disc fitted in this, over the eye which is not undergoing examination; he is then asked to read No. 1 (Jaeger), and if unsuccessful tries No. 2, and so on until he can read one of the reading

types: the number is noted, and the distance at which it is held. He is next asked to read Snellen's distance types, beginning at the largest. Suppose the left eye is under examination and the patient can see No. 1 (Jaeger) at 20 centimetres and No. 6 of the distant types at 6 metres, the facts are expressed thus:

$$\text{L.E. J.1, 20 c.m. } V = \frac{6}{20}.$$

The surgeon next ascertains the point nearest to the eye at which Jaeger's reading type is visible; this point is termed the punctum proximum (p.p.), and is noted. Then the furthest point at which the reading type can be seen is noted; this is called the punctum remotum. The difference between the near and far points is the range of accommodation. The effect of glasses is now tried, and the patient must ascertain the weakest concave glass with which he can see Snellen's No. 6 type at a distance of six metres; as a general rule the lens required is one whose focus coincides with the punctum remotum. To find the focal length in dioptrés of a lens whose focal length in inches is known, divide 40 (about the length of a metre in inches) by the number of inches; thus if the punctum remotum be 8 inches a lens of 5 D will be suitable. If no glasses enable the patient to see No. 6 Snellen at 6 metres his acuteness of vision is affected, due either to defective sensibility of the retina, astigmatism, increasing posterior staphyloma and atrophy of the choroid, opacities of the cornea or vitreous, intraocular hæmorrhage, or partial detachment of the retina. If the myopia be slight, and the patient can see near objects distinctly, handglasses may be used for distant vision when required, such glasses being of sufficient power to fully correct the myopia. In myopia of medium grade from 4 D up to 8 D, glasses will be wanted both for reading and distant vision, and if the patient have a normal accommodation the same lenses will serve. In myopia of higher degrees, or where the accommodation is deficient, weak glasses are required for reading, and stronger for a distance. In very high degrees of myopia, the concaves which enable the patient to read should be constantly worn, and hand glasses used in addition to these for distant objects. In increasing myopia the patient should not use

his eyes in reading much, or minute work. As age advances, if the myopia be slight and stationary, the sight may steadily improve; that is, the near point recedes from the eye owing to presbyopia.

Hypermetropia.—In this affection neither near nor distant objects can be seen distinctly, owing to rays of light coming to a focus *behind* the retina. This may be due to the antero-posterior diameter of the globe being too small, and thus the retina too near the lens, or to the refractive media of the eye being deficient in power, as in cases of absence of the lens or flattening of the cornea. Parallel rays of light falling on a hypermetropic eye, in a state of relaxation, will form their principal focus behind the retina, and therefore distant objects are indistinctly seen. To avoid this the patient uses his power of accommodation, which renders the lens more convex and causes the rays of light to converge and come to a focus on the retina; in consequence of this undue use of the near adjustment, convergent squint is apt to supervene. When the rays are divergent from a near object the difficulty in bringing them to a focus is much greater.

Causes.—It may be “acquired” or “original,” and is very often hereditary.

Acquired.—This form may be met with in old persons, combined with presbyopia, also in persons who have lost the lens (aphakia).

Original.—The degree of the hypermetropia which exists when the patient is using his near accommodation is termed “manifest.” When the near accommodation is paralysed by the use of atropine, the extra amount of hypermetropia existing, which is the true measure of the state of vision, is termed “latent.” Original hypermetropia is divided by Donders into absolute, relative, and facultative.

Absolute Hypermetropia is when the patient can see neither to read print, nor discern distant objects with clearness.

Relative Hypermetropia is applied to the condition when, in order to see clearly a near object, the patient has to converge his eyes as if looking at another point nearer the eye.

Facultative Hypermetropia is when the patient can clearly see distant objects

either with or without convex glasses, and can also with an effort see near objects, but when performing minute work the eyes soon become fatigued and the images blurred (asthenopia). This form is often conjoined with presbyopia.

Symptoms.—The hypermetropic eye is an imperfectly developed eye, smaller in all diameters than a normal eye, but especially so in the antero-posterior diameter. In low degrees there may be no symptoms until the patient be approaching middle age, when he has the usual symptoms of presbyopia, but at a younger age than they should be met with. In high degrees symptoms of fatigue and indistinct vision are complained of. A common symptom is severe headache, especially when the eyes are used for reading. In young children the book is frequently held close to the face, in order to get a large retinal image, and thus the disease may be mistaken for myopia.

Diagnosis. Ophthalmoscopic Tests.—If the fundus be illuminated by throwing the light into the pupil from a mirror held at a considerable distance from the eye (two feet or more), a virtual erect image of the fundus is seen, which does not disappear when the patient is approached, and moves in the *same* direction as the observer's head. In ordinary “direct” examination the same image is seen, and continues clear when convex glasses are placed behind the sight hole of the mirror: the highest convex glass which still gives a clear image is a measure of the hypermetropia. By the *indirect* method the image is larger than in the emmetropic eye, and as the object glass is withdrawn from the eye, the image diminishes in size according to the amount of hypermetropia. By the shadow test, the shadow ‘passes in the *opposite* direction to the mirror, and the degree is ascertained by the convex lens, which placed in a spectacle frame will cause the shadow to pass in the same direction.

Treatment.—Convex glasses, to render the rays of light more convergent. To find out the glasses which are suitable, both eyes are tested separately with reading and distant types. The amount of hypermetropia is measured by the *strongest* convex glass with which the patient can see No. 6 (Snellen) at 6 metres. In order to find out how much

latent hypermetropia is present, the near accommodation is paralysed by atropine drops (gr. iv to $\bar{3}j$), or better a solution of homatropine (gr. viij to $\bar{3}j$), as its effects are more transitory, and the strongest glass now ascertained with which the patient can see No. 6 (Snellen) at 6 metres' distance. It is usual in prescribing glasses to correct all the manifest hypermetropia, and half the latent; thus if the manifest hypermetropia be 4 D, and the latent 4 D, convex glasses of 6 D will be required. If the hypermetropia be under 3 D in an adult, and distant vision be good, glasses need only be worn for near vision, but if above 3 D glasses should always be worn. In the case of children, except when engaged in play, glasses should be constantly worn.

Astigmatism.—This defect depends upon the cornea being unsymmetrical, so that the refraction is different in several meridians of the eye, and rays of light are brought to different foci: if the rays come from a point, a linear image of this point is formed at the focus of each principal meridian, and the direction of the image is at right angles to the focus of the meridian which forms it. Rays of light falling on one of the vertical meridians may be brought more quickly to a focus than those falling on a horizontal one; or the reverse of this may exist; whilst in other cases oblique rays are the most distinct. The cornea of an emmetropic eye is a segment of an ellipsoid, so that its vertical and horizontal axes are of different lengths; thus the curvature in a vertical plane is less than in a horizontal, and rays of light are brought sooner to a focus in a vertical plane than in a horizontal one. This defect is met with, in a slight degree, in all eyes, and vertical and horizontal lines drawn on a paper are not seen from the same distance with equal clearness at the same time. It is only when this fault of symmetry is exaggerated that sight is impaired.

There are two forms of astigmatism:

1. Irregular; 2. Regular.

Irregular Astigmatism is divided by Donders into Normal and Abnormal.

Normal Irregular Astigmatism is due to imperfection in the structure of the lens, producing multiplication of the object (polyopia). The rays of light proceeding from a single centre are unequally refracted by the different sectors of the lens, so that they do not converge to a

point (even after accommodation), but spread out forming indistinct images of the object.

Abnormal Irregular Astigmatism is a consequence of some defect of the cornea or lens, as conical cornea, subsequent to extraction of the lens, change in structure of the lens as in incipient cataract, and partial dislocation of the lens.

Regular Astigmatism. Causes.—It may be congenital or acquired from perforating wounds of the globe, whether surgical or accidental. It is divided into Simple, Compound, and Mixed.

Simple Astigmatism is when one meridian is emmetropic, the other either myopic or hypermetropic. The retina is at the principal focus of one of the meridians.

Compound Astigmatism is when both meridians are either myopic or hypermetropic, but one more so than the other. In the first case the retina is beyond the foci of both meridians, in the second in front.

Mixed.—Where one meridian is myopic and the other hypermetropic, the retina is midway between the foci of the principal meridians.

Cylindrical Lenses.—The surface of a cylindrical lens forms part of the surface of a cylinder. The meridian of the lens parallel to the axis of the cylinder is plane, but the meridian at right angles is curved, and the other meridians have intervening degrees of curvature. If the lens be formed from the external surface of the cylinder it is a convex cylindrical lens; when formed from the internal surface a concave cylindrical lens. The number of the lens is considered to be the refraction of its most refracting meridian. Rays falling on a cylindrical lens are refracted towards the plane of the axis, but the lens has no refractive power in a meridian parallel to its axis, and thus the difference in the curvature between two chief meridians can be rectified by putting the plane of the axis opposite the meridian which is nearest the normal.

Diagnosis.—To ascertain whether the patient be astigmatic. The vision is first tested by convex and concave spherical glasses as before described, to see whether hypermetropia or myopia be present, but if V. cannot with the aid of these glasses be brought to $\frac{6}{6}$, astigmatism is probably present. To

prove this is the case Snellen's test type is used. This type consists of a half circle of radiating lines. With one eye covered the patient looks at the half circle, which is placed at the end of the room, and walks towards it until one line be distinctly visible. This line is the meridian of greatest refraction (emmetropic meridian), and is in most cases at right angles to that of lowest refraction. The patient then tries a series of convex and spherical glasses until the highest convex or lowest concave be found which causes the indistinct lines to be clearly seen. If vision be rendered normal the case is one of simple astigmatism, and the power of the lens used is the measure of the astigmatism. For compound astigmatism, the myopia or hypermetropia is first corrected by appropriate glasses, then in front of these a weak cylindrical glass with its axis parallel to the meridian of least curvature, and if this improve vision other cylindrical glasses are tried of greater strength, until the weakest be found which gives clear vision. The best instrument to test astigmatism, founded on the foregoing principles, is Tweedy's optometer.

Ophthalmoscopic Examination.—The observer cannot see the vertical and horizontal vessels of the retina at the same time, but must alter his accommodation. The disc, if circular, looks oval, and if oval, lies with its long diameter corresponding with the meridian of greatest refraction, by the direct method; and with the long diameter in the meridian of least refraction in the indirect method; in this last method, as the object glass is withdrawn from the eye the disc gradually becomes circular and then again oval, but now with the diameter in the meridian of greatest refraction. By the "shadow test," a difference in the motion of the shadow in two opposite meridians of the eye denotes astigmatism; if the difference be in rapidity or intensity of illumination and shade, the case is either simple or compound astigmatism; if the difference be in direction, then it is a case of mixed astigmatism. The degree of astigmatism is found by correcting each of the principal meridians separately with spherical lenses.

Treatment.—In simple astigmatism, if, in testing, concave spherical glasses are necessary to remove the astigmatism,

a concave cylindrical lens must be worn of similar strength, with its axis parallel to the meridian of normal refraction; if convex, the axis of the convex cylindrical lens must correspond with the healthy meridian. In compound astigmatism spherocylindrical glasses must be used, the least affected meridian being corrected by the spherical glass, and the cylindrical lens to correct the more abnormal meridian being added with its axis in the direction of the corrected meridian, and of sufficient strength, when joined to the power of the spherical glass, to correct the second meridian. In mixed astigmatism, the myopic meridian may be corrected with a concave spherical lens, and a convex cylindrical lens be added to correct the hypermetropic meridian. Or the hypermetropic meridian may be corrected with a convex spherical lens, and a concave cylindrical be added for the myopia. Thirdly, a convex cylindrical lens may be combined with a concave cylindrical lens with their axes at right angles, forming a bi-cylindrical glass.

Presbyopia, or Long Sight.—Donders writes: "The term presbyopia is to be restricted to the condition in which, as the result of increase of years, the range of accommodation is diminished and the vision of near objects interfered with." Senile changes, producing hardening of the structures of the lens and weakness of the ciliary muscle, unite in causing presbyopia. This affection is a natural change as age advances. Up to about forty, the near point should be under 22 centimetres (8 inches); after this age it exceeds this distance, and glasses should be worn. The patient first notices he has to hold a book at a greater distance from the eye to read; this is especially marked when using artificial illumination. In hypermetropia this change takes place earlier than in emmetropia, whilst in myopia, from the punctum proximum being so near the eye, the condition is late in reaching the above-mentioned limit.

Treatment.—As the eye has lost some of its power of accommodation, divergent rays of light from near objects are brought to a focus behind the retina; to diminish this divergence convex glasses are used. The vision should be tested with Jaeger No. 1. The lens must be sufficiently strong to bring the near

point to 22 centimetres, or, in other words, to make up the difference between the amplitude of accommodation still possessed by the patient, and a lens of 4.5 D. At the age of fifty this will be a convex lens of 2 D.

Paralysis of the Muscles of the Eye.—Paralytic Strabismus.

Of the Muscles supplied by the Third Nerve.—The third nerve or motor oculi supplies the levator palpebræ; internal, superior, and inferior recti; inferior oblique, and by a branch to the lenticular ganglion, the ciliary muscle and sphincter of the iris.

Causes.—Rheumatism, syphilis, gout, intracranial disease or injury, intraorbital disease, reflex irritation, locomotor ataxy, etc.

Symptoms.—Paralysis may be complete or partial. If complete, there is paralytic ptosis or drooping of the lid, owing to the levator palpebræ being paralysed, and thus the action of the orbicularis being unrestrained. The superior, inferior, and internal recti being paralysed, there is inability to turn the eye inwards, upwards, directly downwards, or roll the ball upwards and inwards; the external rectus and superior oblique being unaffected, draw the eye outwards and slightly downwards, producing a divergent strabismus. The patient has double vision (crossed diplopia) and becomes giddy if he close the sound eye and attempt to walk while he holds the affected eye open. There is unnatural prominence of the eyeball. The pupil is dilated, and the power of accommodation lost from paralysis of the sphincter iris and ciliary muscle. In cases of partial paralysis, one or more branches of the nerve may alone be affected. If the branch to the internal rectus be implicated, there will be divergent strabismus and crossed diplopia, but the eye can be turned upwards and downwards. When the superior rectus is affected, the globe is displaced downwards and outwards by the external and inferior recti, and the superior oblique muscles, on looking upwards. There is crossed diplopia, the false object being above the level of the true one. When the inferior rectus is alone paralysed, the superior and external recti and the inferior oblique draw the eyeball upwards and outwards on looking downwards. The characteristic phenomenon is crossed diplopia, the false

object being below the level of the true one. In addition to symptoms of diplopia and squint, the position of the patient's head will often draw attention to these paralytic affections of the ocular muscles, as he endeavours by turning his head to avoid the double vision; thus, if the right internal rectus be paralysed, the head will be turned towards the left.

Prognosis.—This depends on the cause of the paralysis, its extent and duration. Unfavourable when depending on cerebral disease; favourable when partial and recent.

Treatment.—When of rheumatic origin eserine drops are useful (gr. iv to 3j); salicylic acid; iodide and bromide of potassium; counter-irritation to the temple. To relieve diplopia the affected eye may be covered with a bandage or dark glass, or a prism worn with its base towards the affected muscle. Electricity is often of service; commencing with the continuous galvanic current, a very weak current, measured by Gaiffe's milliampère galvanometer, of from one to four milliampères should be used, the cathode being applied to the closed eyelids, and the anode over the mastoid process. Sometimes the surgeon's finger is the best reophore when he holds the cathode in his hand. If the eye have recovered some muscular power, a weak faradic current should be used. The sitting must not be longer than three or four minutes. In syphilitic cases iodide of potassium in large doses, combined with mercury, if the patient have not already had a mercurial course. When the paralysis is dependent on local causes, is partial and stationary, strabotomy may be performed on the healthy antagonistic muscle; or De Wecker's operation of capsular advancement on the partially paralysed muscle. Exercise the paralysed muscle by covering the sound eye and making the affected one follow coloured flags moved in the proper direction.

Paralysis of the Fourth Nerve.—This nerve supplies the superior oblique, and, when paralysed, the eye cannot be turned downwards and outwards.

Symptoms.—On attempting to look downwards the eye is turned upwards and outwards, and the globe is twisted so that its vertical meridian occupies an oblique direction downwards and inwards. The most characteristic symptom, how-

ever, is the diplopia ; this only occurs in looking below the horizontal line, the false image is below and outside the true one, and inclined towards it. Each image is opposite its own eye (homonymous).

Treatment.—The same as for the third nerve.

Paralysis of the Sixth Nerve—Abducens.—This nerve supplies the external rectus ; when it is paralysed the eye cannot be turned outwards beyond the middle of the orbit.

Symptoms.—Internal strabismus. Diplopia ; the false image is to the outer side of the true one.

Treatment.—Atropine drops and the general treatment before advised.

Strabismus, or Squint.—According to Donders, this affection consists of a deviation in the direction of the eyes in consequence of which the two yellow spots receive images from different objects.

Varieties.—The two common are Convergent Strabismus and Divergent Strabismus. Monocular strabismus is when one eye only is affected. Alternating or binocular is when the habitually well-directed eye squints if covered. Strabismus may also be periodic—that is, only present at certain times—or persistent.

To ascertain the existence or degree of squint, the patient looks straight before him at an object about twenty inches distant, a hand or card is held over each eye alternately ; if either eye move, when the other is covered, in order to look at the object, there is a squint. To ascertain the degree, the patient looks straight before him, when the squinting eye will turn inwards or outwards ; a mark is then made with a pen on the edge of the lower lid of the squinting eye opposite the centre of the pupil. The sound eye is now covered and the squinting eye directed to the same object, when the latter will become straight and the sound eye squint. The position of the centre of the pupil is again marked on the edge of the lower lid. The distance between the marks is measured, and the squint is said to be of so many lines. The movement which the squinting eye makes when the well-directed eye is fixed on an object is called the “primary deviation.” The movement which the sound eye makes when covered by the hand, the squinting eye being directed to the object, is termed the “secondary deviation.” If

the primary and secondary deviation be equal, the strabismus is said to be “concomitant.”

Convergent Strabismus.—The eye or eyes are turned towards the nose.

Causes.—Predisposing : According to Wharton Jones, are convulsions during infancy, teething, whooping cough, measles, small-pox, worms, injuries and diseases of the head, fright, anger, injuries and diseases of the eye, especially those causing defective vision, as opacities of the cornea, etc., imitation and a habit of misdirecting the eye.—Exciting : *In most cases there is Hypermetropia*, owing to which the internal recti acquire increased strength from the accommodative power being constantly used. Hypermetropic persons frequently have a considerable difference in the refractive power of the two eyes, so the best eye is used constantly to look at objects, and the other is turned in. A simple and efficacious method of testing for binocular vision is Hering's test, which depends on the fact that both eyes can judge with a certainty the relative distances of two objects, which one is unable to do. At a convenient distance from the eyes a tightly drawn transverse string or thread is placed, at which the patient directs his gaze. Small bodies are then dropped close to the thread on the proximal and distal sides, and the patient is asked to state on which side of the thread they fall ; if vision be limited to one eye, the patient cannot correctly judge or answer. The squint in hypermetropia shows itself most frequently when the child begins to read.

Treatment.—When recent and only occasional, it can be removed by the free use of atropine to both eyes, but this will only be temporary ; at the same time if removed completely by atropine, the squint will probably be cured by constantly wearing appropriate convex glasses. Try and find out any predisposing cause, and in children give calomel, followed by grey powder and tonics, as syr. ferr. iod. When persistent, operative measures are necessary.

Strabotomy.—The periosteum lining the orbit sends a reflection from its anterior margin to the transverse meridian of the globe, extending backwards along the optic nerve. This is called Tenon's capsule, and forms a diaphragm, dividing the orbit into two parts, the anterior containing the globe, and the posterior

the muscles and optic nerve. The internal rectus is enclosed in the sheath formed by the prolongation of Tenon's capsule, and is united to this so firmly that it can move the eyeball by means of its attachment to this sheath, even after the tendon is completely divided. The attachment of the internal rectus to the sclerotic is one-sixth of an inch from the cornea.

Division of the Internal Rectus.—Instruments required.—1. Anæsthetic and inhaler, or a 4 per cent. solution of cocaine. 2. Specula of different sizes. 3. Toothed forceps. 4. Strabismus scissors and hooks. 5. Fine curved needles and finest thread or gut. 6. Absorbent cotton and lint. 7. Ice and cold water. A 4 per cent. solution of cocaine applied to the surface of the eyeball, and repeated by means of a hypodermic syringe to deeper layers as the operation is continued, will secure sufficient anæsthesia; but in very timid children chloroform is preferable.

1st Step.—The eye being fixed with a speculum and the forceps, and drawn outwards, a small and deep fold of conjunctiva is seized, with fine toothed forceps, one-eighth of an inch below the equator of the eyeball, and one-fifth of an inch from the margin of the cornea, and divided with blunt-pointed scissors slightly curved on the flat. The incision should be vertical, and large enough to admit the closed blades of the scissors.

2nd Step.—With a few snips of the scissors, directed towards the canthus, Tenon's capsule is divided.

3rd Step.—The strabismus hook is passed through the opening to the lower border of the tendon (close to the sclerotic), first backwards, and then upwards and forwards between the sclerotic and the tendon. The point of the hook is visible under the conjunctiva above the upper border of the tendon.

4th Step.—The conjunctiva may be pushed over the point of the hook, and the tendon divided with scissors close to the insertion, beginning at the upper border; or better, the scissors may be passed along the sclerotic side of the hook, so that one blade passes with the hook beneath the tendon and the other above it, and the tendon then cut through with repeated little snips of the scissors. Dips should be made with the hook upwards and downwards, to see that the lateral

expansions of the tendon are divided. If successfully performed, the hook can be brought to the margin of the cornea without any dragging force.

The risks are wounding the sclerotic, or the posterior part of Tenon's capsule, which will occasion hæmorrhage, and pressure on and atrophy of the optic nerve; divergent strabismus, from too free a division of the subconjunctival fascia.

Modifications.—Liebrich, after making the wound of the conjunctiva, separates this from the capsule of Tenon as far as the semi-lunar fold, also separates the latter as well as the caruncle from the parts behind. After division of the tendons he extends the vertical cut upwards and downwards, and closes the wound in the conjunctiva with a suture.

After-treatment.—If only one eye be operated on, the other should be covered up for a few days, and atropine should be dropped in it if it be hypermetropic. The eye which has been operated on should be cleansed with tepid water, the wound dusted with a little iodoform, and a piece of lint wet with cold water should be tied over the eye directly after the operation and kept there for six hours. If there be much conjunctivitis, apply weak astringent lotions.

When the strabismus exceeds five millimetres in extent both internal recti should be divided. If there be a tendency to divergence directly after the operation, on viewing an object six or eight inches distant, a conjunctival suture should be introduced over the wound, so as to gather the conjunctiva into a fold, and thus limit external movement.

De Wecker performs the following operation for concomitant convergent strabismus which exceeds 25°, the squinting eye alone being operated on.

Operation of Capsular Advancement.—Cocaine is used to procure anæsthesia. A vertical incision is made three to four millimetres long, at the outer side of the cornea and over the insertion of the external rectus. The retraction of the conjunctiva allows the tendinous fibres to be seen through Tenon's capsule. A small opening is made in the capsule over each border of the tendon, and the capsule well separated from its muscle. Ligatures are then passed a little above and below the vertical meridian of the cornea through a bridge of conjunctiva and sub-

conjunctival tissue, the needles carrying the ligatures being then passed in at the upper and lower openings in the capsule respectively, and made to pierce the capsule, tendon, and conjunctiva in emerging. The *internal* rectus is divided in the ordinary manner, and the ligatures are then tied, thus drawing forward the external rectus and its capsule. The effect produced depends on the extent to which the tissues covering the muscle are separated from it, and the distance the ligatures are carried back in piercing the tendon. The operation is easy.

After these operations, spectacles with appropriate lenses should be constantly worn. It is generally found that the eye in which the squint has been fixed has its vision impaired, so that one eye only has been used for visual purposes. Landolt has proved that by proper exercise, etc., binocular vision can be established in many cases.

Divergent Strabismus is much rarer than convergent. The eye is turned towards the temple.

Causes.—Two-thirds of the cases are due to myopia and posterior sclerotic staphyloma. The increased length of the globe offers a mechanical impediment to convergence, and lessens the fulcrum on which the internal recti act; and as objects in myopia have to be held close to the eye, an excessive degree of convergence would have to be maintained; to avoid this, the patient simply uses one eye and the other is allowed to roll out. Any other cause which interferes with binocular vision, as astigmatism, opacities of the cornea or lens, etc. Divergent strabismus generally occurs at a later period of life than convergent.

Treatment.—Strabotomy for divergent strabismus is performed in a similar manner to that for convergent; but it must be remembered that the attachment to the sclerotic of the tendon of the external rectus is further from the cornea than that of the internal rectus (over a quarter of an inch), and is also broader than that muscle. De Wecker's operation can be performed on the internal rectus capsule in a similar manner as before directed.

Extirpation of the Eyeball.—*Enucleation.*—*Excision.*—*Cases suitable for this Operation.*—In staphyloma of the cornea or in the ciliary region of the sclerotic (of traumatic origin), if the bulging be large and unsightly, and particularly if the fun-

dus be unhealthy. After wounds in the ciliary region, to prevent sympathetic ophthalmia. In cases of the lodgment of a foreign body, if this be producing irritation and be not removable by other means. Where there is rupture of the globe, with extrusion of the lens and parts of the iris and choroid, together with much loss of vitreous. In cases of sympathetic ophthalmia, if the wounded eye have lost visual power, in order to save the other eye. In glaucoma, when the vision is lost, and the eye the seat of long-continued neuralgia. In suppurative choroiditis not amenable to treatment. If glioma or sarcoma of the choroid be present. In cases where the eye is filled with blood and clot at the time of an operation. Certain cases of venous nævi of the orbit. Finally, where the eyeball has shrunk from disease or injury, and is no longer of any service as an organ of vision.

Instruments required.—1. Anæsthetic, or a 4 per cent. solution of cocaine. 2. Speculum. 3. Toothed forceps. 4. Curved scissors. 5. Strabismus hook. 6. Small and large sponges. 7. Dissecting forceps. 8. Ice and cold water. 9. Perchloride of iron. 10. Fine curved needles and finest silk thread or catgut. 11. Absorbent cotton or lint. 12. Basin. 13. Bandage.

Operation.—An anæsthetic is administered, or a 4 per cent. solution of cocaine applied to the surface of the eye, and afterwards to the capsule of Tenon. The eyeball is fixed by a speculum and fixation forceps.

1st Step.—The conjunctiva is seized with fine toothed forceps close to the margin of the cornea, and a small opening made with blunt-pointed scissors curved on the flat. One blade is passed through the opening beneath the conjunctiva, while the other remains outside, and the conjunctiva is divided all round the cornea. (If the conjunctiva be very adherent a strabismus hook may be passed before the scissors.)

2nd Step.—The subconjunctival tissues are seized with the forceps at various parts of the wound, and snipped with scissors kept close to the globe.

3rd Step.—Pass a strabismus hook beneath one or other of the recti, and divide it. It does not matter which is taken first, but perhaps the best order is superior, internal and inferior. (The external rectus may also be divided here,

or left till later on. Dixon leaves the internal rectus until the other structures have been divided.)

4th Step.—The eyeball is drawn forwards by pulling on the tendon of the internal rectus and separating the branches of the speculum, the curved scissors are passed backwards along the nasal side of the globe, round the posterior curve, and are then slightly opened and the optic nerve divided.

5th Step.—The globe is now easily pulled forward, and the remaining cellular tissue, the superior and inferior obliques, and the external rectus muscles divided. If the eyeball be very large, after division of the recti, remove the speculum, push the lids back into the orbit, so as to bring the globe forward, or extend the external commissure outwards.

Modification.—Tillaux divides the conjunctiva and subconjunctival fascia with curved scissors along the attachment of the external rectus, divides the tendon of the latter and the optic nerve through the incision. He then seizes the posterior part of the globe with pronged forceps, draws it out through the incision, and divides all the remaining attachments.

Sequelæ.—In a small number of cases meningitis follows this operation, particularly when performed in cases of panophthalmitis, and accompanied by rupture of the globe. The meningitis originates by a septic inflammation of the wound, spreading to the meninges by means of the optic, or sixth nerve, periosteum, orbital veins, or lymph spaces.

After-treatment.—To restrain hæmorrhage, cold water from an Esmarch's irrigator or a sponge; then pack the cavity with a piece of sponge, and keep this in place with a bandage, which can be removed in six hours. Warm water, with some antiseptic, can be syringed for a few days into the orbit. The wound generally heals in a week, and an artificial eye can be worn in six weeks.

Mules' Operation.—This ingenious operation, devised by Mr. Mules of Manchester, should be performed in all cases, instead of extirpation, except where there is danger of sympathetic ophthalmia, or the sclerotic coat is not in sufficiently good condition to be capable of being used. The principle is

to remove all the contents of the sclerotic with a spoon, and then replace them with a glass ball, over which the sclerotic and conjunctiva are joined. The movements and shape of the ball are thus retained, and the cosmetic effects are excellent.

Operation.—(1st Step.) The lids are kept separated by a speculum, the centre of the cornea fixed by a double hook or piercing forceps, and the corneal margin cut all round with a cataract knife, and separated from the underlying parts.—(2nd Step.) The contents of the sclerotic coat are emptied with a Volkmann's spoon, and the cavity cleansed by a small sponge attached to a stick. All bleeding is checked by the pressure of a sponge packed in the cavity.—(3rd Step.) A horizontal cut is made on each side with scissors, and its angles removed, converting the circular into an elliptical incision.—(4th Step.) The glass sphere is now introduced, of a size which will allow the edges of the wound to cover it without stretching the edges. The insertion is easily managed with the help of a clever holder invented by Mules.—(5th Step.) The edges of the wound are united by silk sutures passed through the sclerotic, conjunctiva, and subconjunctival tissues at some distance from the margin.—(6th Step.) The external canthus is cut and a pair of scissors burrowed freely back into the orbit, opening the subsclear space, into which an antisepticised horse-hair drain is inserted. A dry absorbent pad is applied, and an ice bag over all. Any chemosis is relieved by puncture of the conjunctiva after it has been rendered anæsthetic by cocaine.

Resection of the Optic and Ciliary Nerves.—Dr. C. B. Taylor writes: "When an eye, though sightless, is an ornamental appendage, when it is merely affected by neuralgia, by attacks of recurrent inflammation or luminous spectra, which torment the sufferer, or when it belongs to a patient who, although threatened with sympathetic ophthalmia, refuses to submit to enucleation, I think the very best thing we can do for him is to divide the optic and ciliary nerves."

Operation.—(1st Step.) Pick up the conjunctiva immediately over the insertion of the internal rectus tendon, draw up the muscle with a blunt hook,

and divide it close to its insertion.—(2nd Step.) Seize the eyeball with sharp-pointed forceps or hook, pull it well forwards and rotate it, and sever the optic nerve as far back in the orbit as possible.—(3rd Step.) Turn the globe completely round, and shave off the stump of the nerve left attached to its surface close to the sclerotic.—(4th Step.) The divided muscle is reunited and the wound closed.

Dangers.—Hæmorrhage into the orbit, which may prevent reduction of the eye. Orbital cellulitis. Anæsthesia of the cornea is left, but, as a rule, disappears in a few weeks.

Disease of the Lachrymal Organs.

Epiphora is an overflow of tears from the eye, in consequence of obstruction of the derivative lachrymal passages.

Causes.—1. Displacement of the punctum, as in ectropion and lippitudo. 2. Obstruction of the canaliculus from the closure of the opening into the sac; or from blocking by a foreign body, as an eyelash; or from the presence of a cyst or sty. 3. Obstruction of the lachrymo-nasal canal, the result of acute dacryo-cystitis, chronic dacryo-cystitis, stricture, the pressure of a tumour, etc.

Treatment.—This must be directed to the removal of various causes.

Acute Dacryo-cystitis, or Acute Inflammation of the Lachrymal Sac. Causes.—It may be idiopathic, or follow catarrhal ophthalmia.

Symptoms.—Usually only one eye is affected. 1. Hard swelling in the situation of the lachrymal sac, often constricted in the middle by the tendon of the orbicularis; the swelling is followed by redness over the sac. 2. Deep-seated pain, which is increased in severity on pressing the sac. 3. The lids become red, painful, and œdematous, and cannot be separated. 4. Epiphora. The disease may terminate in resolution, but more frequently in suppuration. The pain increases and becomes throbbing, the swelling enlarges and is of a dark red, soft, and fluctuating; finally the abscess points and bursts through the skin, generally below but sometimes above the orbicularis tendon, forming a lachrymal fistula (fistula lachrymalis); as a rare event, necrosis, orbital abscess, or meningitis may ensue. In the old and feeble, and in women suckling, there may be consid-

erable pyrexia, with rigors, furred tongue, sleeplessness, etc.

Treatment.—Fomentations of hot water or poppy heads. One or two leeches in the neighbourhood of the sac. An emetic, as ipecacuanha or antimony. Grey powder or pil. hydrarg. If suppuration have occurred, evacuate the abscess by means of a cataract knife below the tendon of the orbicularis, and in withdrawing the knife enlarge the opening outwards and a little downwards, along the natural line in the skin which exists in this situation. When the inflammation has subsided, slit up the canaliculus and pass probes twice a week. When a muco-purulent discharge remains, inject the sac through a syringe with a fine nozzle, with lotions of alum or sulphate of zinc, twice a week.

Chronic Dacryo-cystitis.—Blenorrhœa of the Lachrymal Sac.—Tumour of the Sac.—Mucocœle. Causes.—Following the acute form; in some cases depending on struma; in others on slight hypermetropia; whilst occasionally it is due to a distinct cystic formation.

Symptoms.—1. Epiphora. 2. Painless and tense swelling in the region of the sac. 3. Pressure on the sac causes mucus or a muco-purulent secretion to escape from the puncta. 4. The eye is irritable, the caruncle and lid inflamed. If untreated this condition may induce caries and necrosis.

Treatment.—Slit up the canaliculus and examine with a probe for stricture. A stricture may be present at: (a) The junction of the canaliculus with the sac; (b) At the junction of the lachrymal sac with the duct; (c) At the opening of the nasal duct into the nose.

Bowman's Operation for Slitting up the Canaliculus.—The lower canaliculus passes down from the punctum for a line, and then proceeds at right angles to this directly inwards into the lachrymal sac, a distance of less than a quarter of an inch. By drawing the lid outwards the canaliculus is straightened. The course of the superior canaliculus is similar. Internally the canaliculi open together into the lachrymal sac, rather above its middle. The lachrymal sac and duct (ductus ad nasum) extend from the inner part of the orbit to the nose. The combined length of the tube formed by the sac and duct is about one inch, of which the upper dilated part is the sac, and the

lower constricted portion the duct. The direction of the sac is downwards and backwards at an angle of 45° , it is situated in the hollow formed by the lachrymal bone and the nasal process of the superior maxilla, and is crossed by the tendo oculi at the junction of the upper and middle thirds. The duct is about half an inch long, and entirely enclosed by bone; it passes *downwards, backwards, and outwards*, and opens in front of the inferior meatus.

Operation.—The patient is seated in a chair; the operator, standing behind him, passes a fine grooved director or a probe through the punctum for a line; the lower lid is then drawn forcibly downwards and outwards and fixed against the malar bone, and the operator passes the director with its groove upwards until it touch the inner side of the lachrymal sac, which is known by the resistance, and the fact that further pressure on the director does not produce any movement of the eyelid. Then holding the director in his left hand the surgeon passes a sharp-pointed knife into the groove and slits up the canaliculus for its whole length, taking care to keep the incision external to the caruncle.

Modifications.—Liebrich's spring knife; Weber's probe-pointed knife without a director; or a pair of scissors may be used.

Treatment of Lachrymal Obstruction.—If there be a stricture at the junction of the canaliculus with the sac, this is known by the probe not feeling the firm resistance of the bony wall, but an elastic sensation, and by there being slight dragging on the margin of the lid, inwards. A guarded knife is passed along the slit-up canaliculus to the point of stricture, the guard withdrawn, and with a little pressure the knife will enter the sac. A Weber's sound or Bowman's dilator is passed into the nasal duct at once, and afterwards daily, and then at greater intervals. The dilator is best introduced by standing behind the patient and passing it downwards and slightly outwards and backwards, so that the handle of the instrument will be situated just over the supra-orbital notch. If the passage of probes will not cure the patient, a style passed through the slit canaliculus must be worn for a time, or the patient may be taught to introduce the style at bedtime and remove it in the morning.

When the stricture is situated at the junction of the sac with the nasal duct, a probe (Bowman's) is passed twice a week, or Weber's conical sound. Stilling's knife is very valuable to divide the stricture in this situation, or lamina-probes may be introduced to dilate the constriction. When the mucous membrane alone is affected, medicated gelatine bougies of iodoform or carbolic acid are serviceable. If the stricture be at the lower end of the nasal duct, a dilator or probe is passed by steady pressure and afterwards at intervals of a few days. Astringent lotions of alum, tannin, or boracic acid may be injected into the sac with a small syringe, and blisters externally over the sac are useful adjuncts. Of late many cases have been successfully treated by electrolysis, an insulated probe being passed down to the stricture, attached to the negative pole of a Leclanché battery, the circuit is completed by applying the positive pole to the mastoid process of the same side; the strength of the current, which is measured by Gaiffe's galvanometer, should be about 4 milliampères.

Fistula Lachrymalis.—*Fistula of the Lachrymal Sac.* *Causes.*—Acute dacryocystitis; occasionally subsequent to caries or necrosis of the bones forming the lachrymal canal.

Symptoms.—A small opening between the sac and the skin, through which tears pass on to the cheek. The fistulous opening may correspond with the sac, or the communication may be through a sinus. The aperture is often very small, and no larger than a pinhole.

Treatment.—Slit up the canaliculus and dilate the stricture. Wash out the sac with stimulating injections by means of a syringe. If this fail, lay the fistula open, with a cataract knife, into the sac, and pack with lint and powdered iodoform for twenty-four hours, then pass probes. If the opening be large, pare the edges and unite with sutures.

Other diseases of the lachrymal organs are—

Dacryoliths, or small calculi, in the canaliculi or sac. These should be cut down on and removed. *Dacro-adenitis*, or inflammation of the lachrymal gland. *Dacryops*, or cyst-like tumour of the lachrymal gland, from obliteration of the excretory ducts. *Dacryops fistulosus*, or fistula of the lachrymal gland, opening

in the upper and outer surface of the lid. *Simple hypertrophy* of the lachrymal gland. *Sarcoma* and other tumours of the lachrymal gland.

Diseases of the Eyelids.—*Hordeolum*, or *Stye*, is a small boil at the edge of the lid, generally due to inflammation of the wall of a sebaceous gland and of the surrounding tissue.

Causes.—It occurs in scrofulous or delicate children; or in persons in a debilitated state of health from anæmia, diabetes, uræmia, chronic constipation, etc. Local causes are any irritation by dust, wind, uncorrected refraction error; diseases of the conjunctiva, lids, or lachrymal apparatus, etc.

Symptoms.—It begins as a small reddish-looking swelling, situated at the edge of one of the lids, most commonly the lower; and as the inflammation proceeds, the whole lid may become red and swollen. There is a smarting pain, which soon becomes more acute, and suppuration takes place, the pus pointing at the apex of the sty. When the small abscess bursts, matter and a slough are discharged, and the part heals. There may be a successive crop of styes, and I have seen these followed by a number of warts along the edges of the lids.

Treatment.—Attend to the bowels by grey powder or calomel, and in adults Hunyadi Janos or Friedrichshall water. Regulate the diet and give tonics. Sulphide of calcium is useful. At the commencement, touching the sty with nitrate of silver may cause it to retrograde. Warm water fomentations or decoction of poppy heads will ease the pain. It is best to allow the abscess to point and burst without interference, but if very painful a slight puncture may be made. Astringent applications, as sulphate of zinc, alun, or perchloride of mercury (gr. $\frac{1}{10}$ to $\frac{3}{j}$), and some form of mercurial ointment, as the yellow oxide, should be applied to the lids.

Abscess in a Meibomian Follicle.—If the aperture of a Meibomian follicle become obstructed a small abscess often results. This can be distinguished from a sty by everting the lid, when it is seen as a yellow spot, situated a short distance from the lid, and surrounded by a vascular area.

Treatment.—Puncture the spot through

the tarsal conjunctiva, and remove the contents with a scoop.

Tarsal Cysts.—*Meibomian Cysts.*—*Chalazion.*—These are met with at all ages, as small isolated tumours, in either the upper or lower eyelid. They are developed from the follicles of the Meibomian glands, commencing as a chronic inflammation in the cellular tissue round the gland. They may be single or multiple, and are painless. They resemble a half pea, with the convex side towards the skin, which is unaltered; to the finger they feel hard. The contents are a solid gelatinous matter, consisting of sebaceous matter, epithelial debris, and fatty substances, or a creamy fluid. The cyst may be situated just under the conjunctiva or in the substance of the lid. On everting the lid the cyst is seen as a reddish-brown patch. The chalazion may inflame, suppurate, and burst; the granulations which follow may form a small flattish growth on the inner side of the lid.

Treatment.—Evert the lid, having previously procured anæsthesia with cocaine, and make a crucial incision from the inside with a Sichel's cataract knife, then pass in a scoop, and extract the contents with a rotatory motion. The bleeding is pretty free, and some days will elapse after the operation before the size of the growth decreases, owing to its cavity containing effused blood. A probe should be passed every third day for a fortnight.

Congenital Encysted Tumour.—*Sebaceous or Dermoid Cyst.*—This is most commonly met with over the external angular process of the frontal bone, but occasionally over the nasal process of the superior maxillary bone, when it may be connected with the meninges of the brain. It is always connected with the periosteum, but is small at birth, and may escape notice. It consists of a delicate membranous wall, containing a pultaceous matter mixed with small hairs. It is well to remember that these tumours sometimes extend far back into the orbit, and in other cases growths similar in appearance are connected with the cranial cavity.

Treatment.—Excise carefully, and avoid breaking the cyst wall.

Nævus, epithelioma, rodent, and syphilitic ulcers may also be met with in the eyelids.

Blepharitis Ciliaris.—*Tinea Tarsi*.—*Tinea Ciliaris* is a disease of the follicles of the eyelashes, accompanied by inflammation of the free edges of the lids.

Causes.—It is common in the poorer classes. Struma. Impure air, damp, insufficient food, dirt, and other unhygienic conditions. Subsequent to measles, scarlet fever, whooping cough, etc. Debility. Errors in refraction.

Symptoms.—It commences with little pustules at the roots of the eyelashes. The margins of the lids are red, swollen, and irritable. The discharge from the pustules dries in crusts matting the hairs together; the eyelashes are loosened, and fall out as the scabs are detached. The eyelids are glued together in the morning on waking. There is great itching at the borders and angles of the lids. Later on the tarsal border loses its sharp outline, and becomes rounded off, the skin and conjunctiva being blended in a red shining cicatrix, destitute of eyelashes and Meibomian orifices. The puncta may be obliterated, and there is some eversion of the lids: this state is termed "Lippitudo." Corneal opacities may occur from exposure.

Treatment.—Strict cleanliness. The lids must be bathed with warm water night and morning, and all scabs removed. The lashes should be cut close to the lids. Pagenstecher's ointment—

R Hydrarg. oxid. flav. gr. xxx,
Olei olivæ fʒij,
Adipis ʒj. M.—

or ung. hyd. nit. dil., or ung. hydrarg. rub. dil. should be smeared along the tarsal borders every night. During the day bathe the parts with lotions of alum, borax, or sulphate of zinc. Where there is much ulceration the edges of the lids may be painted with a solution of nitrate of silver (gr. v—x to ʒj), or smeared with the solid nitrate of silver. In cases of lippitudo the canaliculus should be slit up. The general health must be attended to by tonics, liquor arsenicalis, and attention to the bowels.

Trichiasis, or Inversion of the Eyelashes, occurring whilst the border of the lid is in its normal position. A variety of this disease is termed *distichiasis*, and consists in the inverted lashes forming a second row distinct from the other.

Causes.—*Blepharitis Ciliaris*. Purulent and granular ophthalmia.

Symptoms.—A sense of pricking and irritability, together with watering of the eye. If unchecked it will lead to inflammation and ulceration of the cornea.

Treatment.—If partial, only a few hairs being misdirected, the eyelashes should be pulled out with cilia forceps, with a slow steady pull. Electrolysis by means of a Leclanché battery, using a current not exceeding sixteen milliamperes; a sponge reophore, or covered metal disc, is connected with the positive pole, and a slender steel needle or fine platinum wire in a holder is attached to the negative. The needle is introduced into the hair follicle as far as the papilla, and the sponge or disc, well moistened, held on the skin in the vicinity. A froth issues from the follicle for a few seconds, and then the positive reophore is removed. The hair is now loose, and can be removed with forceps. The operation is painful but effectual. In severe cases excision of the whole row of cilia, or better, an operation on the lid to change its direction, will be necessary.

Operations for Trichiasis (Von Grafe's for changing the direction).—An incision is made along the free border of the lid, on the conjunctival side of the misdirected eyelashes. From each end of this a vertical incision is made through the free border and the skin. The flap is dissected up and fastened with sutures in such a position that the lashes can no longer touch the eyeball.

Arlt's Method consists in isolating the lashes by an incision along the border of the lid, made by inserting the knife between the roots of the cilia and the Meibomian glands, and penetrating the skin 2mm. above the lashes; thus forming a bridge of tissue containing the lashes. A semilunar flap of skin three or four millimetres broad is dissected off the lid beyond this incision. The bridge of skin with the lashes is shifted as much as is necessary, and transplanted into the gap, and attached by its upper margin to the skin of the lid by sutures. The lower edge is left free. All bleeding is controlled by a clamp. Dianoux does not remove any skin, but leaves this connected by its extremities, and makes it exchange place with the bridge containing the cilia, by passing the skin underneath this bridge.

Benson's Method.—Knapp's clamp is applied, and the lid everted as much as

possible. An incision is made through the free border of the lid for its whole length and about six millimetres deep, so placed that all the cilia are in the anterior or skin division. A second clamp is applied to the lip, upper or lower according to circumstances; two parallel incisions are made through the mucous membrane, equal in length to the lid incisions, and varying in distance apart from three to five millimetres, according to the amount of displacement in the cilia to be corrected. The strip of mucous membrane is dissected off with scissors, and any loose fat removed from its under surface. It is then rapidly transferred to the slit in the eyelid and fixed in position by three sutures, one at either end, and one in the middle. The clamp is then removed from the eyelid, considerable hæmorrhage follows for a few minutes, but the transplanted flap generally adheres in twenty-four hours. The lip clamp is removed and the wound left open. Iodoform ointment and a compress of boracic lint are applied to the eye.

Excision of Hair Bulbs.—The lids being fixed by Snellen's forceps or a horn spatula, an incision is made with a cataract knife along the ocular edge of the lashes sufficiently deep to include the roots, but not touching the conjunctiva. A second incision is made through the skin just behind, but parallel to the lashes, and meeting the first incision. The wedge-shaped portion between the incisions, which includes the lashes, is removed, and the wound examined to see if any hair bulbs be left; if so they appear as dark spots. No sutures are used, and a compress of wet lint is applied to the eye.

Entropion, or Inversion of the Eyelids.—This may either be spasmodic or chronic.

Causes.—Of spasmodic: Undue contraction of the orbicularis. After any operation on the eye (as for senile cataract); in children in affections of the eye accompanied by much photophobia. —Of chronic or organic: A contracted and deformed state of the eyelid, resulting from purulent or granular ophthalmia, injuries of the conjunctiva, as burns, application of caustic, etc.

Symptoms.—The irritation of the lashes gives rise to keratitis, ulcers of the cornea, opaque and vascular cornea. The edge of the lid is rolled in, so that the cilia and tarsus are hidden.

Treatment.—If due simply to spasm resulting from photophobia, contractile collodion may be painted along the lids with a brush, and the parts kept quiet until it have dried. If the result of spasm combined with redundancy of the skin, a transverse fold of the latter is seized with forceps close to the margin of the lid and snipped off with a pair of scissors, then the subjacent fibres of the orbicularis are also removed, and the edges of the wound united by sutures. Instead of excision, cauterisation by sulphuric acid is sometimes used. Von Græfe made an incision parallel to and a line from the border of the lid; from the middle part of this as a base, two oblique incisions were made, enclosing a triangular piece of skin, which was removed and the wound closed with sutures. In the upper lid he also excised a triangular piece of cartilage with the apex downwards.

Operations to rectify Entropion, with a contracted and deformed state of the tarsal cartilage.

Streatafeld's.—The eyelid is fixed with Desmarre's forceps, and an incision made parallel to, but one line from, the border of the lid through the skin, so as to expose the roots of the lashes; the edge of the skin is raised from the cartilage, and then two longitudinal vertical incisions are made into the cartilage, two-thirds or more through its thickness, inclined to each other so as to enclose a V-shaped strip, which is removed with the forceps and scalpel. Three sutures are inserted through the lower edge of the skin wound and the upper edge of the groove in the tarsus, and the ends tied tightly together. The upper edge of the skin wound is left to heal by granulation. The principle of this operation is to correct the deformity by shortening the outer surface of the cartilage.

Longitudinal Tarsotomy.—The eyelid is everted, and an incision made through the conjunctival surface, completely dividing the tarsal cartilage a quarter of an inch from the border. This incision must extend the whole length of the lid, but must not touch the skin. The lid is now replaced, and an elliptical piece of skin removed from the outer surface of the lid.

Vertical Division.—This is performed in one or two places by perpendicular incisions through the entire thickness of

the lid. The eyelid being set free, it is fixed in its proper position by ligatures passed through it, and fastened to the forehead or cheek. The wound is allowed to granulate.

Ectropion, or Eversion of the Eyelids.—This may be partial or total.

Causes.—1. Chronic inflammation of the conjunctiva and tinea tarsi. 2. Purulent ophthalmia. 3. From contraction of the skin in consequence of cicatrization of wounds, burns, abscesses, ulcers, lupus, etc. 4. Caries or necrosis of the margin of the orbit. 5. Laxity of tissue in old persons (senile ectropion). 6. Paralysis of the orbicularis.

Symptoms.—When arising from disease the lower lid is most frequently affected. The eyelid being drawn from the eyeball the latter is exposed to constant irritation, and thus repeated attacks of conjunctivitis with ulcers and nebulae occur. Owing to the punctum being displaced outwards away from the eyeball, epiphora is a troublesome symptom. There is great disfigurement, the conjunctiva of the everted lid becoming almost like skin, or presenting a villous granular appearance. The tarsal edge becomes elongated.

Treatment.—The punctum and canaliculus should be slit up. If the lid be granular, and there is no loss of skin, the granular conjunctiva can be seized with forceps, and an elliptical piece removed with scissors parallel to the margin of the lid; or the conjunctiva may be cauterised with nitrate of silver. In more severe cases one of the following operations.

Operations for Ectropion.

1. *Blepharoraphy* (Bowman) is a good means of preventing ectropion in cases of loss of substance of the eyelids, and is a great assistance to other operations; it consists in uniting the borders of the two lids, previously freshened, by sutures, and leaving them closed for months.

2. *Excision of a wedge-shaped piece out of the whole substance of the eyelid when this is much lengthened.*—The necessary breadth of the piece being determined, the eyelid is seized at the selected spot (preferably close to the outer canthus) with forceps, and drawn from the eyeball; then with strong straight scissors, or scalpel, the surgeon cuts out the piece with two strokes. After excision of the piece the edges

of the wound are brought together and united by hare-lip sutures.

3. *Wharton Jones' Method.*—When the ectropion is dependent on a dense cicatrix firmly attached to the subjacent parts, the contracted cicatrix is included by two converging incisions forming a V-shaped wound one inch high, the base occupying the whole length of the border of the lid. By drawing up (lower lid) the triangular flap and cutting all opposing bridges of cellular tissue, but without separating the flap from the subjacent parts, the lid is restored to its place. The gap left, which resembles the letter Y, is closed by two hare-lip pins and twisted sutures.

4. *Guérin's Method.*—Two incisions are made forming an inverted V, the point of which lies just below the centre of the free border of the lid. From the lower extremity of these incisions a third and fourth are carried parallel to the borders of the lid. The two triangular flaps on either side of the V thus marked out, are dissected up, the lid raised to its right position, and the flaps united, so that their apices and that of the inverted V meet at a common point. The gaps left are allowed to granulate.

5. *Dieffenbach's Method.*—When the cicatrix was large Dieffenbach dissected out the scar, the incisions being made so that a triangular wound was left with its base to the margin of the eyelid. He extended the horizontal incision forming the base of the triangle outwards, and carried another incision downwards and inwards from its outer extremity. The square flap thus formed was dissected up and brought inwards to cover the loss of substance. The gap left was united by sutures as much as possible, and the remainder left to granulate. Instead of taking the flap wholly from one side, a part may be taken from one side and a part from the other, and united in the middle by hare-lip sutures.

6. *Argyll-Robertson's Method.*—A suture with two needles; a piece of sheet lead perforated with holes at its inferior margin, one inch in length and a quarter of an inch broad, curved to suit the shape of the globe; and a piece of medium thin rubber drainage tube, are required. The needles are passed through the border of the lid from the skin to the conjunctiva, through the holes in the lead, and out again through the inferior conjunctival

cul-de-sac to the skin, an inch or so below the edge of the lid. The punctures near the lid are half an inch apart, and the counter-punctures below a quarter of an inch apart. The strip of lead is then slipped under the two threads inside the lid, and the drainage tube passed under the external loop of suture near the margin of the cornea. The suture is drawn tight and tied over the lower end of the piece of drainage tube. As the stitch is tightened the border of the lid is bent inwards over the edge of the leaden plate, and the elasticity of the drainage tube keeps up a constant pressure for from five to ten days. The sutures are tightened as is necessary, by passing small pieces of cotton wool beneath them.

7. When the structures of the lid are much destroyed and the lid completely everted, a plastic operation is necessary. This should not be performed until all thickening and induration after the injury have disappeared. The lid is first replaced into its proper position, and the size of the raw surface measured; a skin flap a little larger than this is marked out from the temple or cheek, and dissected up, leaving a good pedicle, which must not be too much twisted.

Wolfe uses transplantation of skin *en masse*. 1. The edges of the lids are first pared without touching the lashes. 2. The affected eyelid is then to be liberated from the cicatrix by an incision through the skin, along its whole length 2 mm. from the ciliary border. 3. The contracted skin is liberated by subcutaneous division so as to form a semilunar raw surface, or, if this be impossible, it must be removed entirely. 4. A piece of skin of the same shape but one-third larger is dissected from some other part of the body, or another individual, and transplanted to the raw surface, where it is secured by sutures. The flap is dressed with warm moist lint, covered over with dry lint, gutta-percha tissue and a bandage.

Ptosis.—Drooping of the Upper Eyelid.—This affection may be partial or complete.

Causes.—1. Paralysis of the third nerve or the branch supplying the levator palpebræ. 2. Injury to the levator palpebræ. 3. It may be congenital, but is then never complete. 4. In old persons,

from extension and relaxation of the skin of the eyelids. 5. Swelling of the lid from any cause.

Treatment.—When due to paralysis, as before directed. In traumatic and congenital ptosis an endeavour must be made to bring the upper lid under the influence of the occipito-frontalis. A longitudinal incision is made through the skin of the upper lid two lines from the free margin, and extending along its whole length. The edges of the wound are drawn apart and dissected back until the fibres of the orbicularis be well exposed; an elliptical strip of this muscle is excised a quarter of an inch wide. The wound is closed by sutures passing through the upper and lower cut portions of the orbicularis.

Pagenstecher's Operation.—A needle armed with thick thread is passed beneath the skin two centimetres above the supra-ciliary ridge, and two millimetres to the outer side of the middle line. It is guided downwards and inwards beneath the skin, and brought out about the middle of the upper lid, close to the ciliary margin. The ends of the thread are tied in a knot and gradually tightened from day to day, so as to cut their way out. Two ligatures are sometimes required. By this means the lid is brought under the action of the occipito-frontalis.

Lagophthalmos, or Inability to Close the Eyelids. Causes.—Paralysis of the facial nerve, from syphilis, rheumatism, or gout. Compression by tumours. Exposure to draughts. Injury. Cerebral disease, as in hemiplegia. Caries of the aqueduct of Fallopius. Protrusion of the eyeball.

Symptoms.—It may be partial as in cerebral disease, or complete when due to local affections. The lids cannot be closed. The lower lid is everted, which removes the punctum from the globe and gives rise to epiphora. The eye is subject to constant irritation from dust, wind, etc.

Treatment.—The same as for paralysis of the third nerve. When occasioned by a local cause this must be removed. To protect the eye, a pad with a light bandage, or the operation of blepharoraphy is necessary. Electric treatment must be directed to the orbicularis.

Morbid Connexions of the Eyelids.

Anchylo-Blepharon consists in the junction of the eyelids to each other at their margins. It may be mediate, *i.e.*, union takes place through the medium of a false membrane; or immediate, by direct cohesion of the free borders. The union may be partial or complete.

Causes.—It is either congenital or acquired. The congenital is generally complete, and either mediate or immediate. The acquired form results from burns or scalds, escharotics, ulceration, or lacerated wounds.

Symptoms.—The lids are generally united at the inner third, but there is almost always, even in complete anchylo-blepharon, a fistulous opening at the inner angle through which tears pass.

Treatment.—When immediate, a small director is passed through the opening at the inner canthus, and upon this the line of union is divided with scissors or a sharp scalpel. If mediate, the band must be divided, and the edges of the lids afterwards trimmed. The edges must be separated every day and smeared with oil.

Symblepharon is adhesion of one or both eyelids to the eyeball.

Causes.—Generally this is due to injury of the conjunctiva from the action of escharotics, as lime, mortar, etc. Burns and scalds.

Symptoms.—It may be “complete,” when the whole of the inner surface is adherent to the globe; or “partial.” It may also be mediate, membranous bands or frena passing from the lids to the globe; or immediate, the union being direct. Sometimes it is conjoined with anchylo-blepharon.

Treatment.—If the union be mediate and the bands small, their connexion with the eyeball may be severed with a scalpel or fine scissors, and the wound in the conjunctiva united by one or two fine sutures. When the wound has healed the band can be removed from the lid and the wound sewn up; care must be taken by daily passing an oiled probe between the cut surfaces to prevent them joining again. Some surgeons prefer to divide the band by means of a ligature. The best means of preventing readherence in extensive cases of symblepharon is transplantation of rabbit's conjunctiva (Wolfe), or the

mucous membrane from the lip or vagina (Stellwag).

Operations for Symblepharon.

Arlt's Method.—A thread is passed through the band close to the cornea, and then the band is dissected off the ball. Both ends of the thread are attached to needles, which are passed through the lid from within outwards. The threads are then tied together outside the lid, thus folding the band on itself and fixing the raw point to the lid. The conjunctival wound is then stitched up.

Teale's Method.—The symblepharon is separated from the eyeball, commencing at the margin of the cornea, any part attached to the cornea being left. Two flaps of the conjunctiva (not including the subconjunctival tissue) are dissected up from the sound part of the eyeball, on opposite sides, with their bases directed to the symblepharon and their borders parallel to the cornea. The inner flap is fixed to the raw surface of the eyelid and the outer to that of the eyeball by fine sutures, and the gaps left by their removal are brought together in the same manner.

Taylor's Method.—The lid is first separated from the eyeball, then a thin piece of skin is dissected from the lid, passed through an incision in the tarsal cartilage, and its raw surface applied either to the lid or eyeball. Nourishment of the flap takes place through its attached base, and as soon as the flap has taken root the base is divided. The skin soon assumes the appearance of mucous membrane.

Injuries to the Eyelids.

Abscess of the Eyelid. *Causes.*—Contusion or laceration of the structures of the lid.

Symptoms.—Redness, often very dusky in hue, swelling fluctuation, and chemosis. Occasionally a hard, localised swelling is met with, resembling a solid growth, and due to effusion of plastic lymph.

Treatment.—Make a horizontal incision on a line with the fold of skin just behind the lid. A fine drainage tube should be inserted.

Wounds of the Eyelids.—If the skin alone be affected it must be carefully united by fine silk or catgut sutures.

When the tarsal border is cut or torn through a notch is formed; when this results from a clean cut, fine pins passed through the cartilage of the lids, and the twisted suture, will bring the edges in juxtaposition. One pin must be passed close to the edge, and a layer of styptic colloid may be put outside the pins and sutures. Lacerated and contused wounds must have their edges pared, and then be adjusted in a similar manner. If the canaliculus be torn through, the torn part must be sought for and slit up on a director, into the lachrymal sac, and then the wound treated as directed.

Diseases of the Orbit.

Protrusion of the Eyeball—Exophthalmos—Proptosis—may be due to: 1. Paralysis of the ocular muscles; 2. Goitre; 3. Any disease of the orbit, as hæmorrhage into the orbit, cellulitis and abscess, periostitis, aneurism, nævus, tumours, etc. 4. Enlargement of the globe from intraocular tumours or glaucoma. 5. Dilatation of the frontal sinus.

Abscess of the Orbit—Cellulitis.—This may be acute or chronic.

Causes.—Traumatic injury, as blows, the entrance of foreign bodies, wounds. As the result of debility after fevers, etc. Erysipelas. Cold. Following periostitis, caries, and necrosis.

Symptoms—Of the Acute Form: 1. Fever. 2. Rigors. 3. Deep-seated neuralgic pain, increased by pressure or movement. 4. Conjunctiva of the lids and globe, red, infiltrated, swollen, and chemosed. 5. Eyelids swollen, red, and shining. 6. Protrusion of the eyeball, and decreased mobility. 7. Impairment of vision from stretching of the optic nerve. 8. Fluctuation, most frequently at the upper and inner side of the orbit. 9. Cornea may be hazy and slough.—Of the Chronic Form: Here the symptoms are similar to the acute form, but there may be but slight pain.

Complications. Of Acute Abscess: 1. Detachment of the retina. 2. Suppuration of the globe. 3. Phlebitis of the orbital veins and cavernous sinus. 4. Encephalitis. 5. Pyæmia. 6. Periostitis of the wall of the orbit. 7. Atrophy of the optic nerve.—Of Chronic Abscess: 1. Caries and necrosis. 2. Periostitis.

Treatment.—An incision must be cautiously made as soon as fluctuation is detected, through the skin between the margin of the orbit and the eyeball; care must be taken not to cut the optic nerve, an accident which would be disastrous to the patient's sight and the surgeon's reputation. A drainage tube should be inserted. Afterwards, warm water dressing should be applied. If the lids be severely pressing on the protruded globe, the upper lid should be vertically divided with a cataract-knife. Atropine is often necessary to relieve pain, in the form of discs and warm lotions. The general treatment must be supporting, a nourishing diet and stimulants being requisite. Internally, opium, with liq. ferr. perchlor. and spirit. chloroform. A good purge of calomel is of service in the commencement. After the abscess has been opened matter may continue to be discharged from the sinus for some time; stimulating injections are necessary in this case. Should there be any dead bone this must be removed, when detached, in the usual manner.

Periostitis of the Orbit may be acute or chronic. The acute form may be diffuse or localised. Diffuse suppurative periostitis presents the local symptoms of acute abscess, together with a high temperature, severe headache, and delirium, passing on into coma. The localised acute form is marked by deep-seated radiating pain and other symptoms of orbital inflammation, and a very tender swelling can often be felt on pressing with the finger against the roof of the orbit. The danger is that a meningitis may supervene.

The chronic form is generally due to syphilis or struma, but also occurs in rheumatism. The nodes are met with on the frontal bone above the brow, or just within the orbit, attended by deep-seated pain, much increased at night time, œdema and redness of the lids. Suppuration may occur, and necrosis or caries. Paralysis of some of the orbital nerves may be present. If the periostitis be confined to the cavity of the orbit there may be protrusion of the eyeball.

Treatment.—In the acute forms an incision must be made through the periosteum right down to the bone without waiting for signs of suppuration. In the chronic form iodide of potassium

in large doses. Opiates to relieve pain, and ung. hydrarg. c. belladonn. smeared round the orbit. If suppuration occur evacuate the matter. Dead bone must be removed if present.

Aneurisms of the Orbit.—1. True aneurism of the ophthalmic artery. 2. Diffuse aneurism. 3. Aneurism by anastomoses. 4. Aneurismal varix.

True Aneurism of the Ophthalmic Artery.—*Symptoms.*—1. Sudden onset, accompanied by a snap or crack. 2. Protrusion of the eyeball. 3. Pulsation of the globe (pulsating exophthalmos). 4. A loud bruit heard with the stethoscope applied over the side of the head. 5. Pressure symptoms, as congestion of the conjunctiva, internal strabismus, ptosis, external strabismus, etc. 6. Cerebral symptoms, headache, giddiness, loud noises in the ear on stooping, etc.

Diffuse Aneurism.—As affecting the ophthalmic artery such a condition has not yet been met with, but diffuse aneurism of the carotid in the cavernous sinus is of more frequent occurrence. The symptoms are similar to the preceding variety, and a pulsating tumour may be detected at the orbital margin.

Aneurism by Anastomoses is a congenital disease, though it may not be apparent until it have spread to the external structures. The capillary vessels in the subcutaneous connective tissue are enlarged, both arteries and veins forming a tumour beneath the skin which becomes livid and increased in size on crying. It has a soft, doughy feeling.

Aneurismal Varix is by far the most common cause of a pulsating exophthalmos. It may be of traumatic or idiopathic origin. When traumatic, it may be due to fracture of the skull, gun-shot wound, punctured wound, or other injury to the skull or orbit. The symptoms generally appear within a few weeks, but may be delayed. They are similar to those of aneurism of the ophthalmic artery; the first being a whizzing, blowing, beating, or singing noise in the head, followed at a greater or less interval by protrusion of the eyeball, etc. The pathology of this affection is a communication forming between the carotid artery and the cavernous sinus.

Treatment.—Digital compression of the carotid, which may be intermittent. Ligature of the common carotid on the same side. Iodide of potassium and the

general treatment for aneurisms. Aneurism by anastomoses, if possible, should be ligatured; if too large for this, electrolysis may be tried; and, as a final measure, ligature of the carotid.

Venous Nævus is congenital and rare.

Symptoms.—Protrusion of the eyeball, increased on crying. No external tumour may be visible or to be felt when the nævus is fully within the orbit, but if it have advanced there may be perceived an elastic, soft, non-pulsating mass. The lids may be involved. This affection may be stationary, or increase, causing extreme protrusion of the globe and ulceration of the cornea.

Treatment.—If possible ligature the nævus subcutaneously, or try the actual or galvanic cautery. If increasing rapidly and the eye be destroyed from ulceration of the cornea, etc., excise the ball and cut away the nævus with scissors, stopping the bleeding by plugs of lint soaked in perchloride of iron.

Tumours of the Orbit.—Any kind of tumour may be met with in the orbit.

Symptoms.—1. Misdirection, displacement, and protrusion of the eyeball. 2. More or less pain and feeling of distension. 3. Movements of the eyeball limited. 4. Impairment of vision. 5. Œdema of the eyelids. 6. Sloughing and ulceration of the cornea may occur later on, if the eyelids do not cover the ball.

(a) *Tumours arising within the Orbit.*—These are cysts, either atheromatous, steatomous, hydatid, or serous, and must if possible be excised. Fibrous tumours growing from the periosteum, which should be removed with their periosteal root. Exostoses and enchondromata, which should be split off with bone forceps, gouges, bone chisel, elevator, and an Archimedean drill. Sarcomata and carcinomata require extirpation of the globe and the structures within the orbit, followed by a liberal application of chloride of zinc paste.

(b) *Tumours spreading to the orbit from the eyeball.*—These are glioma and sarcoma of the choroid.

(c) *Congenital Tumours.*—These are rare, and may be connected with the membranes of the brain. They may be cystic, nævi, meningoceles and encephaloceles.

(d) *Tumours spreading to the orbit from other parts,* as growths of the antrum,

frontal sinuses, lachrymal canals, base of skull, etc.

Ophthalmoscopy is the method by which the interior of the eye is examined. An instrument termed the ophthalmoscope is used. The principle of this instrument, which was discovered by Helmholtz, depends on bringing the eye of the observer in the axis of the cone of light which passes through the pupil of the eye under examination. The ophthalmoscope in its essential particulars consists of a mirror about two inches in diameter, made of polished silvered glass or metal, and perforated for the eye of the observer; in the indirect method a convex lens is also necessary.

Mode of application.—Two methods are used: 1. The indirect; 2. The direct.

The Indirect.—The patient is seated on a chair opposite the examiner, with the lamp on one side and sufficiently behind the patient to throw his face in the shade; the lamp should be on a level with the patient's eye. The mirror being held in the surgeon's right hand (for the right eye) close to his own eye, and at a distance of from one to two feet from the patient's face, the light is directed into the pupil to be examined, until it be seen of a bright red colour. The double convex glass of $2\frac{1}{2}$ to 3 inches' focus is held in the other hand of the examiner, in front of the affected eye, the surgeon steadying his hand on the patient's forehead. By slowly moving the mirror backwards and forwards, the proper focal length is found and a distinct blood-vessel traced to the optic disc, by slightly moving the lens in the opposite direction. The optic disc is best seen when the patient fixes his left eye by gazing at the surgeon's right ear; and for the right eye, when he looks at the left ear. The image seen is an inverted aerial one situated between the mirror and the surface of the lens, and at or near the focus of the latter. Great care must be taken that the light, surgeon's and patient's eyes are at the same level. By this method a general inverted view of the fundus is obtained. By placing a convex lens of seven dioptries behind the mirror the surgeon can approach nearer the patient, and the illumination will be better.

The Direct Method is now generally used. By this method is given a more magnified appearance, but a smaller portion of the fundus is visible. The eye of

the patient is illuminated in the same way, but the surgeon brings his eye with the mirror close to the patient, say within two or three inches. The surgeon should use his right eye to examine the right eye of the patient, and his left eye for the patient's left. If the patient be emmetropic or normal no lens is necessary, as the cornea and lens of the eye under examination serve as a magnifying apparatus. But should the patient or observer suffer from any error of refraction, as myopia, a concave lens sufficiently strong to convert the rays from the myopic fundus into parallel ones is necessary, and is best placed behind the mirror; if hypermetropia be present, a convex lens is required. For this purpose an ophthalmoscope is used, fitted with a number of convex or concave lenses, which can be changed by a single mechanical arrangement. The instrument of Dr. Loring is a good one. The chief points to be observed in an ophthalmic examination are: 1. The transparency of the dioptric media; 2. The state of the optic nerve and vessels; 3. The appearance of the macula lutea; 4. The appearance of the fundus at the other parts of the picture; 5. Any errors in refraction.

Appearance of a normal fundus.—The entrance of the optic nerve or optic disc is visible as a pinkish white circular spot, with a sharp, well-defined, distinct outline. The margin is slightly raised and the central part depressed. The surrounding retina varies in tint from pale red to deep orange, and is pervaded by vessels. When the patient looks directly forwards the macula lutea or yellow spot is visible, quite destitute of vessels, and through which the choroid shines a little more deeply than in other parts, causing the spot to appear as a dusky oval or roundish patch. The central artery and vein of the retina perforate the optic disc, forming several trunks. The vessels ramify in radiating branches over the surface of the retina, crossing the optic disc in straight lines. The veins are of a deeper colour, more tortuous, and obtain branches at considerable angles. The arteries are of a paler red colour than the veins, and marked by a central bright line, and divide regularly in pairs. One appearance of the disc must be alluded to, which is due to the fibres of the optic nerve dividing in the trunk and separat-

ing by the time they reach the disc, so that a central space is left destitute of nerve fibres (porus opticus), and through which the lamina cribrosa of the sclerotic coat shines with a white lustre. This condition is termed the physiological cup, the vessels bending gently round this. It

is distinguished from the pathological cupping by a normal band of the disc being always round it, and its edges being bevelled or sloping.

The pathological appearances of the fundus have been described under their respective diseases.

APPENDIX.

LIST OF CHIEF WORKS AND PAPERS CONSULTED.

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- Agnew, *Principles and Practice of Surgery*.
- Allingham, W., *Fistula, Hæmorrhoids, etc.*
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- Cornil and Ranvier, *Manuel d'Histologie Path.*
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- *On the Structure and Diseases of the Testis*.
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- Diday, P., *Syphilis in New-born Children*.
- Dieulafoy, G., *Pneumatic Aspiration of Morbid Fluids*.
- Donders, *On the Accommodation and Refraction of the Eye*.
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- *Selections from Works*.
- Davy, *Surgical Lectures*.
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